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STRAIN INVESTIGATION OF GRASSES AND CLOVERS.

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4. WHITE CLOVER (Trifolium repens).

(Concluded.)

Trials at Plant Research Station.

THE white clover trials initiated at the Plant Research Station, Palmerston North, are divisible into three sections, as follows: (1) *Broadcast plots* started in 1928; (2) *row trials* with seed from commercial sources, and seed-heads and plants collected from a wide range of old swards throughout New Zealand; (3) *spaced plants*. The results from these trials will be discussed under the related headings.

(1) BROADCAST PLOTS SOWN NOVEMBER, 1928.

In this trial 104 lines of commercial white clover were sown out in duplicate plots. Each plot was approximately $\frac{1}{1300}$ acre in area. The seed lots dealt with represented eighty-seven New Zealand lines, eight lines of Kentish Wild White, and nine lines of ordinary European and English white clover.

Detailed analyses have been comparatively difficult in connection with this trial, since volunteer growth of weed grasses and white clover has to a considerable extent masked the first year's results. Subsequently, however, the volunteer white has largely disappeared, and the differences between plot and plot becomes increasingly marked as time goes on.

The rise to dominance of volunteer white clover, followed by its rapid disappearance, is significant, and is a point of far-reaching economic importance to the grassland farmer. In many districts the inclusion of white clover in permanent grass mixtures is neglected on the score that white clover comes in naturally and that there is no need to sow it. While this is to a certain degree true, it is important to realize that on most soil-types the volunteer self-sown white is essentially a short-lived, heavy-seeding form which, in fact, is able to "volunteer"

in the young sward just because it is an abundantly seeding type. In many cases, of course, particularly where old leas are broken up, the volunteer white may be quite a good type. The sowing of a good persistent and vigorous strain of white clover is just as essential on land where white clover is propense as it is on country where it does not come in rapidly. Indeed, we would go so far as to say that it is most essential on good white clover country that a good strain of white be sown. The natural coming-in of white clover is itself an indication that fertility and soil requirements are correct for the species, and the sowing is therefore all the more assured of success than on poorer country.

In the broadcast plot trial under review the New Zealand Wild White types showed differences consistently from the outset. They germinated and established themselves rapidly, and to a considerable extent were able to keep volunteer growth in check. After the experiment had run for eighteen months the differences became greater, and the superiority of the New Zealand Wild White plots became more marked. (Figs. 14–17.)

Table 1 shows the relative ground cover of white clover on these plots sown with the contrasting types of commercial seed. New Zealand Wild White No. 1 has been placed at 100, and the data for the other types are given on a relative basis. It will be noticed that there is a very definite gradation in the relative persistence of the various plants.

Table 1.—Relative Persistency (= Ground Cover); Broadcast Trials sown November, 1928. Hay Conditions. One and a Half Years and Two Years old.

New Zealand Wild White No. 1 = 100.

Type.	Number of Lines.	Relative Production on	
		29/3/30.	13/11/30.
New Zealand Wild White No. 1	7	100	100
New Zealand Wild White No. 2	6	78	80
Ordinary New Zealand containing trace New Zealand Wild White Nos. 1 and 2	17	67	49
Ordinary New Zealand free of New Zealand Wild White	54	45	37
Kentish	7	71	64
Dutch = ordinary imported	8	45	40

The ordinary New Zealand lines are completely less persistent than the New Zealand Wild White types, and the latter in this trial have done much better than Kentish Wild White. The Kentish type has been low in relative production throughout this experiment; it does not seem to have been able to withstand the prevailing volunteer grass and weed competition, and thus shows up at a disadvantage relative to New Zealand Wild White.

Kentish white is of proven permanency under normal conditions in Britain, and there is evidence also to show that this clover has a definite sphere of usefulness in our New Zealand grasslands. The evidence from the present trial would indicate that on first-class country in New Zealand Kentish Wild White is not able to make good establishment nor to compete successfully with other and stronger growths in the sward,

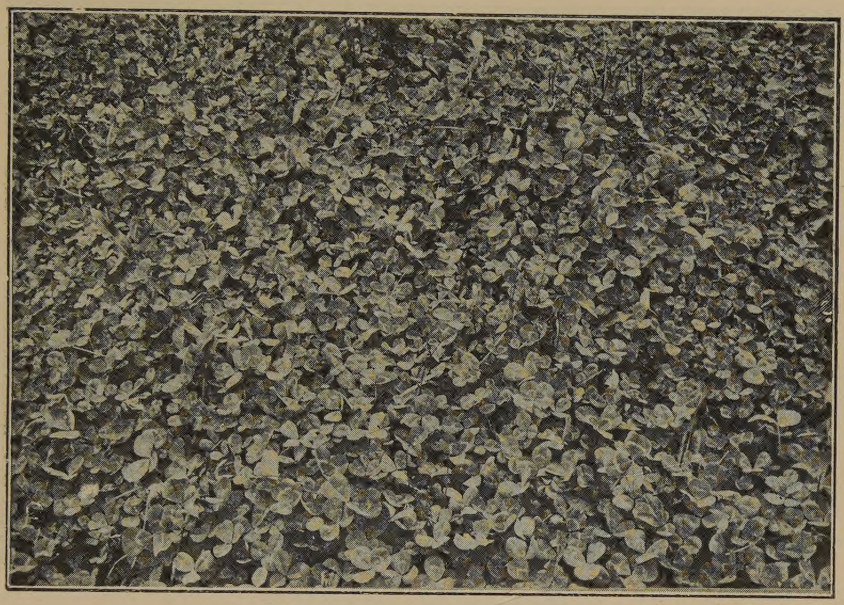

FIG. 14.

FIG. 15.

New Zealand Wild White No. 1, showing good persistency and growth after nearly two years. Hay section, periodically mown (Fig. 14), and weekly-cut section (Fig. 15). Compare with Figs. 16 and 17.

[*Photos by Wm. Davies.*

FIG. 16.

FIG. 17.

Poor New Zealand and imported type, showing poor persistency and growth after nearly two years. Hay section, periodically mown (Fig. 16), and weekly-cut section (Fig. 17). In the hay section volunteer grass has largely replaced the clover, and in the weekly-cut section the clover is almost entirely replaced by mat-forming weeds.

[*Photos by Wm. Davies.*

The New Zealand Wild White forms have on the other hand proved most aggressive throughout the course of the experiment, and to date of writing have persisted well and been highly productive. Judging from this trial, and having regard to trials conducted at Weraroa and at Marton during the past ten years, we feel confident in asserting that New Zealand Wild White is of the greatest economic significance to the grassland of the Dominion.

The Italian Ladino white has persisted well under hay conditions in this trial, but has been completely killed off under the system of weekly cutting. The ordinary imported white clover and the ordinary New Zealand type (approximately 60 per cent. of the total white clover crop of New Zealand) have failed badly in these and subsequent trials from a total production and persistency point of view. Had it not been for the lots of New Zealand Wild White (some 10 per cent. of the total crop) and admixtures of this with the ordinary New Zealand (in approximately 30 per cent. of the total crop) there would have been very little in this and subsequent trials reported upon below to place New Zealand white superior to imported. The figures in Table 1 make this fact very clear. We would like to point out also that many of the lines included in these ordinary New Zealand lots have been shipped from the Dominion under the trade name "New Zealand Wild White."

(2) Intercultivated Rows.

In order to overcome the influence of volunteer white clover during the period of establishment from seed, the white clover trial started in November, 1929, was sown in drills 15 links long and 2 ft. apart. Two adjoining drills were sown with the same line of seed, so that when properly established the rows could run together to form a plot 15 links long by 4 ft. wide (= approximately $\frac{1}{1100}$ acre). Altogether this trial deals with 631 distinct lines of seed drawn largely from New Zealand commercial samples. A considerable number of lines have been hand-collected from old pastures and roadsides all over New Zealand, and forty-two lines were from overseas, fifteen of these being of Kentish origin. In one block of 336 plots one row of each plot was sown in steam-sterilized soil, and the adjoining row sown with the same line of seed in ordinary soil. Soil sterilization was a further attempt to develop a technique whereby it could be assured that volunteer white clover did not interfere with the result of the trial. It, however, soon became apparent that with seed sown thickly in the rows and the rows intercultivated during the period of establishment, volunteer growth is effectually checked even without resorting to the use of sterilized soil.

Some interesting observations were made in connection with the soil-sterilization drills. The seed sown in these established rapidly, and made extraordinarily rapid seedling growth in comparison with that sown in ordinary soil. The photograph reproduced in Fig. 20 was taken on 13th January, 1930, about eight weeks after sowing. Growth notes made on 4th February, 1930 (eleven weeks after sowing), show that for the average of all 336 plots the relative growth in unsterilized soil was 74 per cent. of the growth in the sterilized soil. As will be judged from the photo the relative growth-rates were much more pronounced in January, when the photo was taken, than they were in February, when the actual measurements were made. Subsequently the drills

evened up, and at present there is no difference in the majority of cases between the sterilized and non-sterilized drills. In the case of low-establishing lines such as Kentish Wild White, however, there is still a discernible difference, due largely to the greater prevalence of volunteer grass in the non-sterilized drills. This again emphasizes that rapid establishment of white clover is an important factor in weed control.

Throughout the experiment Kentish Wild White and ordinary imported white were used as opposing types in check plots. Each 15-link drill was sown with 1 gramme of seed, representing a fairly heavy seeding rate.

Table 2 deals with the growth analyses of 631 lines of white clover covering the whole of the first year after sowing down. The growth produced by the New Zealand Wild White No. 1 is placed at 100 for

Table 2.—Relative Production of Contrasting Types of White Clover during First Year of Growth.

New Zealand Wild White No. 1 = 100 at each period. Sown in drills, November, 1929. Analysis of 631 lines.

Type.	Number of Lines averaged.	Percentage of Lots of each Type in New Zealand commercial white Clover.	Relative Production on		
			4/2/30.	30/7/30.	16/10/30.
New Zealand Wild White No. 1	37	6·3	100	100	100
New Zealand Wild White No. 2	20	3·4	95	92	89
Ordinary New Zealand plus trace New Zealand Wild White	179	30·4	97	80	81
Ordinary New Zealand free of New Zealand Wild White	344	58·4	87	51	64
New Zealand " Dutch " types	9	1·5	87	27	36
Kentish	15	..	68	55	74
Dutch = imported	25	..	98	37	45
Ladino imported	2	..	100	75	68

each recording date, and the figures show that none of the other types studied have surpassed it in growth during the first year. It is significant to note that the differences were least marked at the first record (three months after sowing) and most marked in the following winter and spring periods. The data indicate the marked superiority of the New Zealand Wild White, first in rapidity of establishment and then in the ability to maintain a high standard of production, particularly during the winter.

Long seasonal growth—particularly summer and winter growth—is one of the most valuable attributes of any species or strain, and perhaps the greatest value of strain studies centres around the production of out-of-season growth. Strains that produce more summer or more winter growth are invaluable, even though the total yearly growth may not exceed that of the ordinary strain. In dairying and in sheep-farming it is extremely difficult to assess the per-ton value of grazable herbage during " bottle-neck " periods, and just as our artificial manuring should in large measure be directed towards promoting feed for these periods of growth, so in like manner should

strain work be pursued. The normal white clover that perpetuates itself by reseeding makes scanty summer growth, and its re-establishment from seed in the autumn is too late to produce winter growth. In consequence, what is normally obtained from these types is a flush of moderately late spring growth, when grazable feed per ton is at its minimum value.

In our trials Kentish Wild White at no time during the first year approached New Zealand Wild White in production. The persistency attributes and the excellent swarding capacity of the Kentish variety, particularly under soils of lower fertility standards, may prove to be factors defining the place of this type in the grasslands of New Zealand.

The ordinary New Zealand white types as well as imported lines have made poor growth relative to the best of the New Zealand Wild White. Add to this their relatively poor persistence, and it is clear that the poorer types are of little real value as constituents of high-production grasslands. The bulk of ordinary New Zealand white is a considerable improvement upon the ordinary imported whites. New Zealand white is more productive, and although not unlike imported white in general type, yet is more productive and rather more persistent.

At the time of writing (January), after hay-cut made in mid-December, all New Zealand lots, with the exception of those (1·5 per cent. of lines) definitely marked New Zealand "Dutch" types, are recovering better than the imported lines (Figs. 18 and 19). New Zealand Wild White are outstanding in recovery, but in this respect are surpassed by Ladino white, which under hay conditions in both the 1928 and 1929 sown series is outstanding for rapidity of recovery after cutting. (Fig. 18.)

Table 3.—Relation of Fertility of Habitat to Type of White Clover growing therein.

Hand-collected samples from old pastures and roadsides. — Fifty-four lots analysed. Sown or planted in rows, 1929.

Type.	High-fertility Soils.		Average-fertility Soils.		Low-fertility Soils.		Tussock Country, South Island.	
	Number of Lines.	Percentage of Lines.	Number of Lines.	Percentage of Lines.	Number of Lines.	Percentage of Lines.	Number of Lines.	Percentage of Lines.
New Zealand Wild White No. 1	5	38	..	..	..	..	..	..
New Zealand Wild White No. 2	1	8	3	11	..	..	..	..
Ordinary New Zealand with trace of New Zealand Wild White	6	46	10	36	..	..	..	..
Ordinary New Zealand with no trace of New Zealand Wild White	1	8	15	53	8	100	5	100
Total	13	100	28	100	8	100	5	100

Relation of Habitat to White Clover Type.—The data given in Table 3 are based upon (1) hand-collected seed samples grown in drills, (2) plants

FIG. 18.

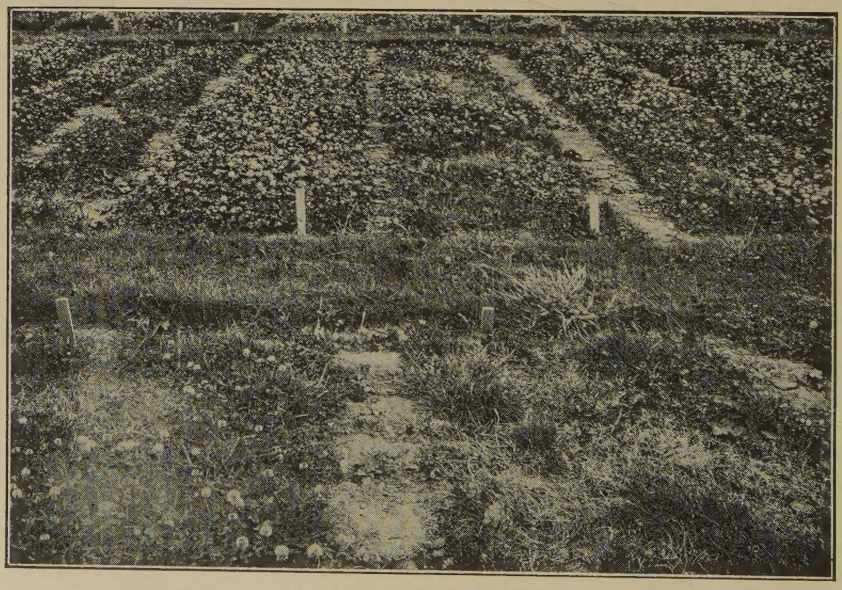

FIG. 19.

These photos show summer recovery after cutting various types of white clover in second year after sowing. Fig. 18—In foreground, Ladino (middle row); ordinary New Zealand (plot on left); Kentish Wild White (one row on right). Fig. 19—In foreground, poor New Zealand type on left; imported type on right. In mid-background, New Zealand Wild White No. 1 on left; poor New Zealand type on right.

[*Photos by E. Bruce Levy.*

collected from old pastures and roadsides in various districts throughout New Zealand and grown in plots at the Plant Research Station. The localities from which the seed and plants were collected have been divided into three classes—high fertility, medium or average fertility, and low fertility. The tussock grassland areas (normally of low fertility) have been included as a fourth group. Indications are that New Zealand Wild White No. 1 is largely confined to soils of high fertility, while on poor soils, including the tussock grasslands, only the poorer economic types occur. On average fertility soil-types the ordinary New Zealand forms are found predominating, but in most instances there are traces of New Zealand Wild White in these lines. It is largely evidence of this nature, together with many general observations, that leads us to formulate the somewhat new ecological concept of the distribution of strains within a species, each strain an ecotype specially evolved to suit the particular need of the habitat, and stressing in grassland farming the greater need for particular care in which strain is employed, just as one considers the species included in the grass-seed mixtures sown.

(3) Spaced Plants.

The study of the individual plants contributing to the make-up of any lot of seed represents the third system of testing white clover at this Station. Altogether over 10,000 single plants of white clover have been spaced out for study. The present report deals only with 3,360 plants, covering the period up to twelve months after planting out. These represent fifty-six lines of New-Zealand-grown seed, four lines of ordinary imported seed, and six lines of Kentish Wild White. Ordinary imported and Kentish were used as check plots throughout the experiment. Seed was sown in boxes of sterilized soil in August, 1929, and fifty seedlings of each of the New Zealand lines were transplanted into their permanent quarters in October, 1929.

Single-plant analysis has shown that very few lines of commercial white clover show any marked degree of uniformity in type. There is found a general resemblance within the dominant group of plants making up a line of seed, but there is a lack of uniformity when considering any given characteristic in detail. In some of the very best lines examined occasionally quite poor plants occur; conversely, in lines that are considered very poor as a whole we have found a few plants conforming to the better types. The mixed nature of the lines appears to be more marked in New Zealand than in North European seed. The latter is relatively true to a dominant growth-form, although that form is an extremely poor one looked at from the permanent-pasture point of view.

There is abundant scope in New Zealand white clover for selection of the best and culling of undesirable forms, and having this end in view, spaced-plant studies, where each individual can be examined in detail, are essential. The initial project in commercial strain improvement must, however, be the wide-scale reproduction of the best and correct strains for each purpose in view, and the substitution of these in place of the present less desirable undescribed types already on the market. While this replacement is being effected in practice the plant-breeder can by knowledgeable selection build up mass-selected lines

that are superior even to the best of the strains here recognized. Following on this, more intensive breeding of valuable types that approach genetical purity should be undertaken. This latter project involves detailed studies taken over a number of years, and is not of immediate concern to the seed trade.

Table 4 shows the relative growth-performance of the several types of New Zealand and imported lots in the spaced-plants trial. The data for the New Zealand Wild White No. 1 are placed at 100 at each of the four growth-periods. The records again emphasize the value of New Zealand Wild White during the period covered by the trial.

Table 4.—Relative Growth as Single Plants during First Twelve Months of the contrasting Types in New Zealand White Clover.

New Zealand Wild White No. 1 = 100 at each recording period. Seedlings planted out November, 1929. Analyses of 3,360 spaced plants, representing fifty-two lines of New Zealand commercial and ten overseas lines.

Type.	Relative Growth, 1930 (Four recording Dates).			
	28th February —Summer.	28th March— Autumn.	25th June— Winter.	5th October— Spring.
New Zealand Wild White No. 1 ..	100	100	100	100
New Zealand Wild White No. 2 ..	91	93	69	53
Ordinary New Zealand	80	80	41	21
New Zealand "Dutch"	74	58	18	5
Kentish Wild White	76	76	38	29
Imported—average types ..	76	80	33	18
Imported—poor forms	66	55	15	5

The relative poorness of ordinary New Zealand and the lax early-flowering types is evident, but these are superior to the equivalent forms found in ordinary imported seed. The Kentish type has, on the average, shown up badly against New Zealand Wild White; it made poor winter growth and was very late in starting active spring growth. Individual plants in Kentish Wild White are, however, quite healthy—this in contrast to plants of ordinary imported and the poorer New Zealand lots, which are decidedly weakening and in which there have already been numerous cases of winter killing.

The reader will realize that most commercial lines of seed are very mixed in type, and hence the relative growth as between type and type is telescoped, as it were, in the broadcast plots. In the single-plant analysis, however, the grouping is more distinct, and only plants of a definite type (phenotype) are classed together. In this way the real difference between the performance of distinct and contrasting types can be the more clearly enunciated; such was intended in the construction of data given in Table 4.

Type of White Clover in relation to District of Origin.

In connection with our white clover trials it has become increasingly evident that a larger proportion of the better commercial types in New Zealand were grown for seed in certain districts than in others, depending largely on the soil-fertility standard of the habitat. (See Table 3.)

FIG. 20. SHOWING RELATIVE RATES OF WHITE CLOVER ESTABLISHMENT SOWN IN STERILIZED SOIL AND ORDINARY SOIL.

The sterilized soil (middle and alternate rows) greatly increased rate of establishment and seedling growth. Photo shows technique of seeding in rows in order to control volunteer white. A later phase, where the rows have spread out to form a "broadcast" plot, may be seen in Fig. 19.

[Photo by E. Bruce Levy.

FIG. 21. GENERAL VIEW OF PORTION OF CLOVER AREA. SINGLE-PLANT WHITE CLOVER TRIALS IN BACKGROUND.

[Photo by H. Drake.

Table 5 gives the relative growth of lines definitely known to have been grown in various seed-producing districts in New Zealand, the data being drawn from our spaced-plant trials. The averages have been computed quite irrespective of type, and are therefore analyses of the first-year performance of lines coming from various sources in New Zealand, with imported lines included for comparison. On the

Table 5.—Relative Growth of White Clover Lines from different Districts of Origin in New Zealand compared with imported.

Hawke's Bay lines at 100 at each date. All ex-single-plant analysis. Seedlings planted out November, 1930.

Origin.	Number of Lines.	Relative Growth in 1930.			
		28th February—Summer.	28th March—Autumn.	25th June—Winter.	15th October—Spring.
Hawke's Bay	10	100	100	100	100
North and Mid Canterbury (including Sefton and Rangiora)	20	93	91	66	47
South Canterbury	3	95	100	50	25
Marlborough	10	94	96	71	46
Southland	4	93	87	54	37
Wairarapa	2	89	86	62	39
Ordinary imported	..	84	79	47	29
Kentish Wild White	..	87	91	66	63

average of trade lines, those from Hawke's Bay (Heretaunga Plain) proved to be the best yielders, and therefore the data for Hawke's Bay white have been taken at 100 in the computation of the table. There is a considerable proportion of New Zealand Wild White harvested in Hawke's Bay, while the bulk of commercial lines coming from other districts is of the ordinary New Zealand type. The relative behaviour of these lines is noteworthy. A certain number of lots grown in the Sefton-Rangiora district of Canterbury are about on a par with those of Hawke's Bay origin, but the number of poorer-growing types reduces the average growth of these lines to a lower figure than for Hawke's Bay. Seed grown in the arable districts of South Canterbury, as well as that grown in the arable areas around Lake Ellesmere (Mid-Canterbury), is normally not superior to ordinary white clover. The South Canterbury type appears to be about the poorest and least persistent of the New Zealand whites. It is more than probable that the New Zealand Wild White clover type is fairly abundant and widespread, but all the evidence before us suggests that it is largely confined to old pastures on fertile soils, including the alluvial plains and valley bottoms throughout New Zealand.

Conclusion.

The main purpose of this report dealing with the preliminary white clover strain trials conducted at the Plant Research Station is to emphasize to farmers, seed-growers, and the trade generally that important type differences occur within this species. It has long been known that source or country of origin is a factor of considerable importance in connection with commercial white clover. The general

seeds-mixture investigational work in Britain, for example, has shown that for conditions obtaining in that country Kentish Wild White clover is particularly suitable as a constituent of high-class grazing swards. European white clover, on the other hand, has been conclusively shown to give rise to inferior pasture types.

In New Zealand there is abundant evidence to show that ordinary imported white clover is not suited to pasture requirements in the Dominion. There have been outstanding examples of the success of Kentish, but this strain has never become established in the seed trade of New Zealand. Some outstanding results have been obtained from time to time with certain lines of New Zealand white, while results in Britain have shown New Zealand seed to be erratic in behaviour, sometimes giving good results and at other times proving no better than ordinary North European white clover. The reason for this erratic behaviour is elucidated by the evidence secured as a result of our trials.

It has been clearly desirable to survey the white clover as marketed in this country, and to test as large a number of lines as possible under properly controlled conditions. The trials have shown conclusively that wide differences occur in commercial samples of New Zealand white, and that it is possible to classify them into groups of different economic value as pasture plants. The types we have described as New Zealand Wild White have been shown to be of outstanding merit, both in production and persistency, over the first two years after seeding, while the older trials of the Agriculture Department at Weraroa and Marton indicate that New Zealand Wild White is persistent and productive over a ten-year period. Ordinary white clover, whether the seed be New-Zealand-grown or imported from overseas, must, on the best soil-type at least, be regarded as of inferior value for permanent grassland.

It is certain that New Zealand Wild White as a type is bound to have a wide utility range in the grasslands of this Dominion, and probably for all first-class grasslands overseas. It is obviously a wise course to earmark the best aggregate lines at present available, and to have these reproduced as rapidly as possible, so that they may come into general usage, replacing the present less desirable forms. The machinery of seed certification initiated by the New Zealand Department of Agriculture is destined to assist very materially in the development of this project, indeed it is difficult to see that such a move could be brought to fruition without efficient and well-controlled seed certification.

The reproduction and wide distribution of the best strains in commerce is an important step forward, but at the same time it does not represent finality. There must proceed the mass selection of the best individuals within the best and most promising lines. The material so selected would ultimately form the basis of élite strains, which, if after thorough trial proved worth going on with, could be made available to seed-growers and the trade. This selection work is the province of the plant-breeder, and is an essential preliminary to his main problem of building up genetically pure material of proven economic value. This latter represents the more or less final phase, the successful outcome of which will go

far towards placing the white clover seed trade of New Zealand on a sound pedigree basis. The time must rapidly be drawing near when herbage seeds will be placed on a proper pedigree basis, just as trade in cereals, fodder-crops, and live-stock is already conducted to a large extent.

In the attainment of the effort towards the production of pedigree white clover seed there are several important problems, largely in connection with the management of seed-growing paddocks, which call for solution. There is, for example, the need for knowing just what constitutes efficient isolation of a pedigree clover-seed crop so that its trueness to type may be maintained in practice. There are problems connected with the growth of volunteer white clover and how far this will affect the purity of the seed-crop. There are also important problems connected with the general management and manuring for seed. The successful seed-grower of the future will be the man who is highly skilled both in the technique of seed-growing and in the efficient management of a pedigree seed crop.

Our thanks are due to Messrs. Gorman and Saxby, Research Assistants in Agrostology, and to Mr. J. W. Todd, Farm Overseer, for assistance rendered in observation and measurement records, and in upkeep of the Research Area.

SCLEROTIUM DISEASE OF PLANTS.

Sclerotium disease (*Sclerotinia sclerotiorum*) probably attacks a greater number of different kinds of plants than any other fungus. Among its wide range of hosts are winged, spear, Californian, sow, and milk thistles, antirrhinums, larkspurs, tomatoes, potatoes, cabbages, swedes (when seed stems have been developed), artichokes, sunflowers, broad-beans, peas, lucerne, tree mallow, lettuce, lemon, and apple and pear fruits in store.

The disease commonly attacks the stem slightly above ground-level and develops as a definite canker. If this is cut open, black round or sausage-shaped bodies are disclosed. These are the sclerotia, which vary in size from that of a turnip-seed to that of a pea. If diseased parts are not destroyed the sclerotia remain after other parts have decayed, and eventually give rise to spores from which the disease is further propagated.

When the disease has been at work for some time the leaves turn yellow and wilt, and finally the stem collapses, death being due to lack of food and water, the fungus having choked up the vessels and thus retarded movement up the stem of the host. Diseased plants should be burned.

In the field crop-rotation is of distinct use, but its value is to some extent nullified because of the wide host-range of the parasite. The fungus is favoured by sour soil conditions; hence the use of slaked lime at the rate of 1½ lb. to the square yard is worth while in gardens. Certain obscure points relating to the disease are the subject of investigation by the Mycological Laboratory.

—*Mycological Laboratory, Plant Research Station.*

TESTING OF PUREBRED DAIRY COWS.

REVIEW OF THE NEW ZEALAND CERTIFICATE-OF-RECORD SYSTEM IN 1930.

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THE calendar year 1930 must be written down as one of the good years of the C.O.R. system. The number of cows qualifying for certificate showed an increase of 152 over the previous year; three new class-leaders made their appearance; and, despite the larger number of certificates issued, average production rose by over 4 lb. of butterfat. The average production for all certificates issued was 474·02 lb., as compared with 469·95 lb. in 1929.

The additional 305-day class came into operation during the course of the year, but the support accorded to it has not been very strong so far.* The highest month of the current season showed a total of 990 cows on test on the farms of 300 breeders. Of these, seventy-two cows entered by twenty-seven breeders were in the 305-day division; that is to say, only 9 per cent. of the testing breeders availed themselves of the new class, and 7·27 per cent. of the total cows were entered for that class. The total entries in 1930 represent a creditable increase over the peak month of 1929, with its 864 cows entered by 272 breeders.

FIRST-CLASS CERTIFICATES ISSUED.

The Dairy Division has now (up to the end of 1930) issued first-class certificates to 7,171 cows, this total being made up as follows: Jerseys, 5,032; Friesians, 1,495; Milking Shorthorns, 391; Ayrshires, 194; Red Polls, 58; Guernseys, 1. During 1930 certificates were issued on first performances for 568 cows, and on second or subsequent performance for 75 cows, making a total of 643 certificates issued during the year. Details are given in the following table, figures for 1929 being also stated for purposes of comparison:—

Table 1.

Breed.	1930.			1929.		
	Ordinary.	Repeat.	Total.	Ordinary.	Repeat.	Total.
Jersey	454	54	508	315	52	367
Friesian	78	18	96	68	18	86
Milking Shorthorn ..	21	2	23	26	..	26
Ayrshire	13	1	14	6	2	8
Red Poll	2	..	2	1	2	3
Guernsey ..	..	..	..	1	..	1
Totals ..	568	75	643	417	74	491

*A special article on the introduction of the 305-day test was published in the *Journal* for August, 1930, page 108.

Second-class Certificates.

Thirty-four second-class certificates were issued during the year, these going to twenty-five Jerseys, six Friesians, and three Milking Shorthorn. Grouping the cows of each particular breed into one class, the Jerseys averaged 488·95 lb. butterfat, the Friesians 516·46 lb., and the Milking Shorthorns 467·66 lb. The number of second-class certificates issued in 1929 was twenty-eight.

Jerseys.

Class-leaders.

The Jersey class-leaders show one change from the 1929 list, the alteration being in the three-year-old class. In reality two records were broken during the year, both occurring in this one class. At the end of 1929 the leader of the Jersey three-year-olds was Mr. P. J. Petersen's Ivondale Golden Lass, with 905·01 lb. butterfat. In July, 1930, the cow Cousin Grace, owned by Mr. J. Bones, Kaipaki, Ohaupo, qualified for certificate on a yield of 935·21 lb. and assumed the leadership. Six weeks later, however, Mr. P. J. Petersen, Brixton, regained the honour, when his Ivondale Silver Rainbow completed her requirements for certificate on a production of 950·63 lb. butterfat, a particularly good performance, considerably enhanced by the fact that she was milked only twice daily for the full milking-period. Photos of both these cows appeared in the *Journal* for September, 1930.

The list of Jersey class-leaders is now as follows:—

Table 2.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Butterfat.
		Yrs. dys.	lb.		lb.	lb.
Junior Two-year-old.						
Ivondale Oxford Lass	R. S. Tuck, Waharoa..	1 338	240·5	365	12,107·7	731·29
Senior Two-year-old.						
Ivondale Golden Rainbow	P. J. Petersen, Waitara	2 311	271·6	365	12,962·2	768·46
Three-year-old.						
Ivondale Silver Rainbow	P. J. Petersen, Waitara	3 327	309·7	365	15,073·4	950·63
Four-year-old.						
Keston Flower ..	G. E. Yelchich, Waiuku	4 64	319·9	365	14,679·2	814·95
Mature.						
Holly Oak's Annie..	W. T. Williams, Pukehou	5 9	350·0	365	18,522·7	1,056·49

Jersey Class Averages.

The Jersey average of 466·78 lb. butterfat for 1930 showed an increase of 11·27 lb. over the 1929 average of 455·51 lb.—a very creditable position when it is considered that 141 more Jersey cows were certificated during the year under review than in the preceding twelvemonth. A decrease occurred in the four-year-old and senior two-year-old classes, while the remaining three classes recorded an increase.

The class averages for 1930 and 1929 are shown in the following table :—

Table 3.

Class.	Number of Cows.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
	1930.		lb.	lb.
Junior two-year-old ..	200	349	7,273·3	406·21
Senior two-year-old ..	52	342	7,631·7	439·87
Three-year-old	60	340	8,829·0	503·01
Four-year-old	69	342	9,153·3	505·27
Mature	127	344	9,690·2	535·16
	1929.			
Junior two-year-old ..	164	342	6,930·3	387·64
Senior two-year-old ..	29	352	8,202·4	468·42
Three-year-old	45	347	8,850·5	495·46
Four-year-old	44	342	9,403·9	525·45
Mature	85	340	9,630·7	524·68

The averages, class by class, of all certificates issued to Jersey cows since the commencement of the C.O.R. system are given in the following table :—

Table 4.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
			lb.	lb.
Junior two-year-old ..	2,275	345	7,012·6	392·22
Senior two-year-old ..	601	344	7,732·0	436·26
Three-year-old	855	342	8,427·4	469·95
Four-year-old	577	345	8,923·9	494·91
Mature	1,407	345	9,362·3	513·59
All	5,715	344	8,071·3	448·73

Jersey C.O.R. Bulls.

Some 353 Jersey bulls are now listed as sires of four or more daughters with first-class certificates of record, each daughter being from a different dam. The Jersey C.O.R. bull list was increased by thirty-three during the year. No new bulls were added to the New Zealand Jersey Cattle Breeders' Association's special champion bull class, the total remaining at ten under the existing conditions, which are as follows: Each bull must have five or more daughters (each from a different dam) which, under first-class C.O.R. conditions, have produced 520 lb. butterfat when starting test up to three years of age, 580 lb. when starting between three and four years old, 640 lb. when starting between four and five years of age, or 700 lb. when five years old or over. (Last year's review stated nine champion bulls, but this should have been ten, an error having been subsequently discovered.)

FIG. 1. MEADOWVALE EVERLASTING (MRS. G. E. O'SULLIVAN, TE TAWA).

C.O.R. in Jersey mature class: 13,874·4 lb. milk, 827·55 lb. butterfat. Highest C.O.R. in this class for 1930. [*Dairyfarmer photo.*

FIG. 2. ROSEVALE QUEEN DAPHNE SYLVIA (T. SHERIFF, CLANDEBOYE).

C.O.R. in Friesian senior two-year-old class: 23,742·3 lb. milk, 748·12 lb. butterfat.

Friesians.

Class-leaders.

The year under review brought no changes to the Friesian class-leadership list. Many good records were made, even though they did not closely approach the existing highest yields for the various classes. One of the most creditable performances was that of Totara C.R. Buttercup, a senior two-year-old owned by the Piri Land Company, who gained a certificate for 790·66 lb. butterfat from 21,208·6 lb. milk. In the senior three-year-olds Totara Sylvia Lass, under the same ownership, reached the high figure of 826·39 lb. butterfat from 23,475·4 lb. milk. The highest Friesian record of the year was 856·72 lb. butterfat, the cow being Rosevale Queen Daphne Triumph, owned by Messrs. H. North and Sons, Omimi. The list remains as follows :—

Table 5.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Butter-fat.
		Yrs. dys	lb.		lb.	lb.
Junior Two-year-old.						
Monavale Queen Bess	T. H. Richards, Cardiff	2 16	242·1	365	20,501·1	740·50
Senior Two-year-old.						
Pareora Echo Blossom	T. Sheriff, Clandeboye	2 223	262·8	365	22,671·9	819·81
Junior Three-year-old.						
Monavale Queen Bess	T. H. Richards, Cardiff	3 56	282·6	365	21,609·3	800·18
Senior Three-year-old.						
Manor Beets Daughter 2nd of Ashlynn	C. A. Hopping, Palmerston North	3 296	306·6	365	18,733·9	863·51
Junior Four-year-old.						
Westmere Princess Pietertje	John Donald, Westmere	4 156	329·1	365	24,199·0	939·78
Senior Four-year-old.						
Bainfield 27th ..	C. H. Potter, Pukerau	4 351	348·6	365	23,203·3	910·74
Mature.						
Alcartra Clothilde Pietje	Vernon Marx, Mangatoki	7 355	350·0	365	31,312·5	1,145·24

Friesian Class Averages.

The average C.O.R. Friesian for 1930 produced 528·04 lb. butterfat, in comparison with 534·51 lb. for 1929. Although there is a decrease in three of the classes, some strikingly high averages have been attained, nine senior four-year-olds having averaged 620·68 lb., while twenty-one mature cows averaged 614·48 lb. The class averages for 1930 and 1929 are set out in Table 6.

Table 6.

Class.	Number of Cows.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
	1930.		lb.	lb.
Junior two-year-old ..	36	340	12,377·3	443·26
Senior two-year-old ..	13	356	15,061·6	539·11
Junior three-year-old ..	10	354	14,382·2	500·17
Senior three-year-old ..	4	349	16,714·4	577·10
Junior four-year-old ..	3	333	11,264·1	411·65
Senior four-year-old ..	9	352	17,834·2	620·68
Mature	21	350	16,586·2	614·48
	1929.			
Junior two-year-old ..	25	347	13,631·1	477·98
Senior two-year-old ..	12	353	13,458·9	477·34
Junior three-year-old ..	4	359	17,549·8	598·48
Senior three-year-old ..	10	324	14,774·2	527·45
Junior four-year-old ..	5	356	17,296·2	601·58
Senior four-year-old ..	10	328	15,869·8	564·49
Mature	20	354	17,675·6	598·47

The averages, class by class, of all certificates issued to Friesian cows since the commencement of the C.O.R. system are given in the following table :—

Table 7.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
			b.	lb.
Junior two-year-old ..	536	344	11,550·1	409·13
Senior two-year-old ..	241	347	12,549·3	445·42
Junior three-year-old ..	172	342	13,296·4	466·75
Senior three-year-old ..	168	336	13,803·5	493·20
Junior four-year-old ..	108	343	14,836·6	522·91
Senior four-year-old ..	114	345	15,826·0	550·75
Mature	500	340	15,760·7	551·92
All	1,839	343	13,653·1	481·24

Friesian C.O.R. Bulls.

Four bulls were added to the Friesian list during the year, making a total of 103 to the end of 1930.

Milking Shorthorns.

Class-leaders.

The Milking Shorthorn class-leaders remain as at the end of 1929. The mature class was the strongest of the year under review, and registered some good records. The most outstanding were those of Riverdale Peach 4th, 752·32 lb. butterfat, and Matangi Elizabeth 2nd,

731·98 lb. The first-mentioned cow was owned and tested by Mr. T. W. Wardlaw, Waimana, and the latter by Messrs. Ranstead Bros., Matangi. The list is repeated as follows :—

Table 8.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Butter-fat.
		Yrs. dys.	lb.		lb.	lb.
Junior Two-year-old.						
Matangi Quality 4th	Ranstead Bros., Matangi	2 109	251·4	365	14,572·8	591·89
Senior Two-year-old.						
Matangi Quality 5th	Ranstead Bros., Matangi	2 204	260·9	365	11,752·8	542·66
Junior Three-year-old.						
Matangi Quality 4th	Ranstead Bros., Matangi	3 153	292·3	365	16,281·4	678·02
Senior Three-year-old.						
Matangi Ruth 2nd ..	Ranstead Bros., Matangi	3 304	307·4	365	14,032·7	747·86
Junior Four-year-old.						
Matangi Matilda 4th	Hon. Mrs. E. J. Blyth, Kohimarama	4 0	313·5	358	14,640 2	630·38
Senior Four-year-old.						
Matangi Ruth 2nd ..	Ranstead Bros., Matangi	4 355	349·0	340	11,670·3	644·90
Mature.						
Glenthorpe Lady ..	A. J. Melville, Buckland	Mature	350·0	365	20,136·2	856·85

Milking Shorthorn Class Averages.

The average for the twenty-three Milking Shorthorns tested in 1930 works out at 449·44 lb. butterfat, as against 466·54 lb. for 1929. Particulars of the class averages for the two years are as follows :—

Table 9.

Class.	Number of Cows.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
	1930.		lb.	lb.
Junior two-year-old ..	4	332	6,985·8	288·73
Senior two-year-old ..	3	339	7,981·7	332·21
Junior three-year-old ..	..	..	..	..
Senior three-year-old ..	1	365	12,429·3	482·20
Junior four-year-old ..	1	351	12,550·9	478·04
Senior four-year-old ..	1	324	10,131·3	453·11
Mature	13	338	12,537·9	520·93
	1929.			
Junior two-year-old ..	2	309	9,466·5	400·67
Senior two-year-old ..	3	342	10,491·7	471·25
Junior three-year-old ..	2	313	10,468·3	433·41
Senior three-year-old ..	1	339	8,872·9	343·29
Junior four-year-old ..	2	332	12,132·4	468·17
Senior four-year-old ..	2	335	8,645·5	351·19
Mature	14	337	12,287·0	504·72

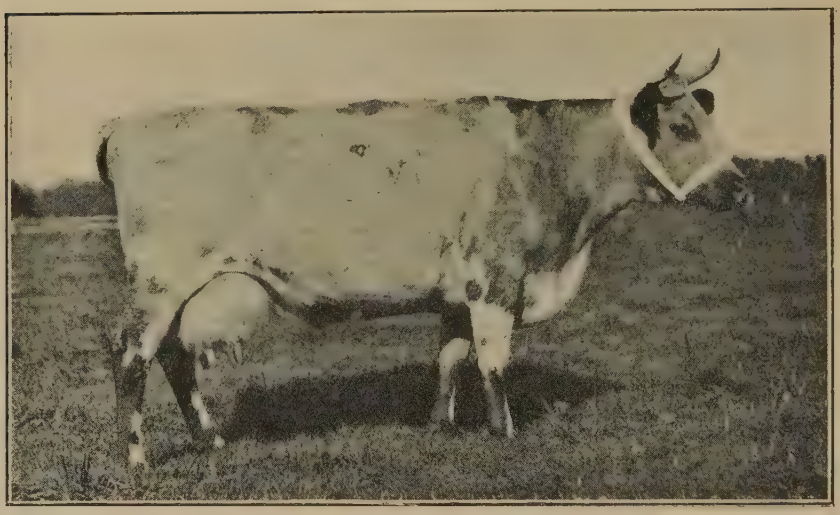

FIG. 3. MATANGI ELIZABETH 3RD (RANSTEAD BROS., MATANGI).
C.O.R. in Milking Shorthorn mature class: 17,074·5 lb. milk, 731·98 lb. butterfat. [*Dairyfarmer photo.*

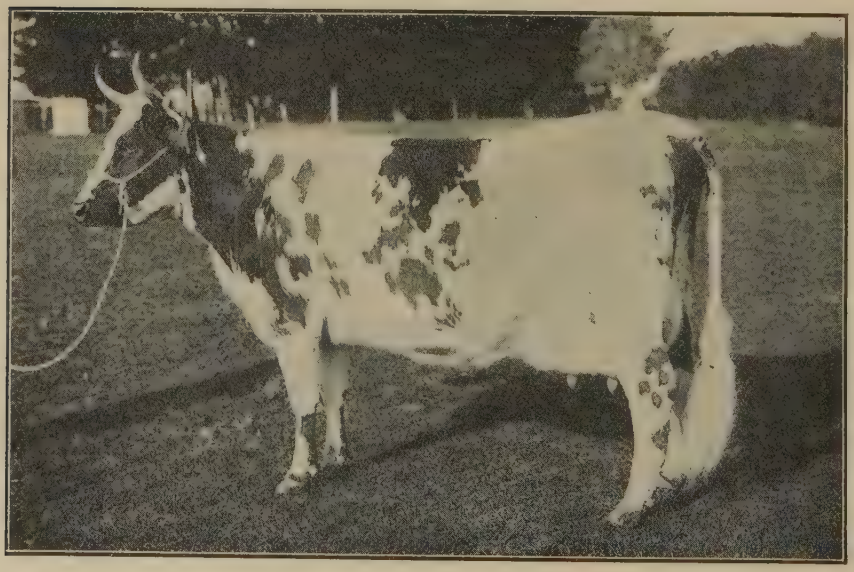

FIG. 4. MAESGWYN VICTORIA (C. MORGAN WILLIAMS, KAIAPOI).
Leader of the Ayrshire three-year-old class: 16,507·7 lb. milk, 646·98 lb. butterfat.

The averages, class by class, of all certificates issued to Milking Shorthorn cows since the commencement of C.O.R. testing for this breed in 1914 are given in the following table :—

Table 10.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
			lb.	lb.
Junior two-year-old ..	53	348	8,374·6	343·79
Senior two-year-old ..	30	345	8,656·8	358·08
Junior three-year-old* ..	22	333	9,594·6	383·88
Senior three-year-old ..	24	343	10,628·2	448·26
Junior four-year-old ..	21	347	11,081·6	444·99
Senior four-year-old ..	27	342	11,557·5	457·76
Mature	254	340	11,707·4	469·36
All	431	342	10,877·4	438·72

* No additions in 1930.

Milking Shorthorn C.O.R. Bulls.

The C.O.R. bulls of this breed now number twelve, four bulls having newly qualified during the past year.

Ayrshires.

Class-leaders.

One Ayrshire class-leadership record was broken during the year. In the three-year-old class Mr. W. Moore's Fair Lass of Greenbank, 630·85 lb. butterfat, gave way to Mr. C. Morgan Williams's Maesgwyn Victoria, with 646·98 lb.

The Ayrshire class-leaders are now as follows :—

Table 11.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Butterfat.
		Yrs. dys.	lb.		lb.	lb.
Two-year-old.						
Fair Maid of Greenbank	W. Moore, Homebush	2 27	243·2	365	12,281·3	673·56
Three-year-old.						
Maesgwyn Victoria ..	C. Morgan Williams, Kaiapoi	3 250	302·0	365	16,507·7	646·98
Four-year-old.						
Ivanhoe Fancy ..	A. M. Weir, Menzies Ferry	4 308	344·3	365	14,207·7	713·93
Mature.						
Floss of Braeside ..	W. Moore, Homebush	7 287	350·0	365	20,305·5	832·72

Ayrshire Class Averages.

First-class certificates were issued to fourteen cows in 1930, an increase of six certificates over 1929. There were five cows in the two-year-old class, with an average of 450·08 lb. butterfat; four three-year-olds averaging 467·06 lb.; one four-year-old with 361·28 lb.; and four mature cows averaging 484·41 lb. The average for the breed, fourteen cows, was 458·40 lb. The eight cows certificated in 1929 averaged 481·48 lb. butterfat.

The averages, class by class, for all certificates issued to Ayrshire cows since the commencement of the C.O.R. testing in 1912 are supplied by the following table:—

Table 12.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
			lb.	lb.
Two-year-old	56	343	8,844·5	366·19
Three-year-old	36	346	10,056·1	413·29
Four-year-old	25	345	11,209·6	454·65
Mature	103	348	11,945·0	486·93
All	220	346	10,763·1	440·48

Ayrshire C.O.R. Bulls.

The Ayrshire bull list increased by two during the year, and now totals seven.

Red Polls.

Only one Red Poll breeder had cows under C.O.R. test during the year, this being Mr. W. Jackson, of Waihou. Mr. Jackson gained two certificates, both cows having passed their minimum butterfat requirement by a creditable margin. One cow, Waihou Best Girl, commenced test at the age of 1 year 311 days, and produced 394·62 lb. butterfat; the other, Waihou Bright Light, was 7 years 5 days old at start of test, and gained a certificate for 515·51 lb. Neither record affected the class-leadership list, which remains as follows:—

Table 13.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Butter-fat.
		Yrs. dys.	lb.		lb.	lb.
Two-year-old.						
Wayward 6th B No. 1	G. S. Young, West Plains	2 188	259·3	365	11,228·0	511·42
Three-year-old.						
Dominion Gold Top..	Central Development Farm, Weraroa	3 302	307·2	365	9,491·25	459·46
Four-year-old.						
Wayward 6th B No. 1	G. S. Young, West Plains	4 297	343·2	365	13,290·0	580·05
Mature.						
Wayward 6th B No. 1	G. S. Young, West Plains	6 349	350·0	365	11,404·8	536·50

Red Poll Class Averages.

The averages, class by class, for all certificates issued to Red Poll cows since the commencement of the C.O.R. testing for this breed in 1918 are as follows :—

Table 14.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
			lb.	lb.
Two-year-old*	37	343	7,580·1	337·61
Three-year-old*	13	346	7,881·1	343·17
Four-year-old*	6	343	9,909·1	425·86
Mature	20	335	10,191·6	431·79
All	76	342	8,502·7	370·31

* No additions in 1930.

Red Poll C.O.R. Bulls.

There has been no change in the Red Poll list, the number remaining at three.

We record once more our appreciation of the assistance and co-operation of the secretaries of the various breeders' associations whose breeds are represented in the C.O.R. testing.

PHTHORIMAEA MOTH ATTACKING TOMATO PLANTS.

THE potato moth, *Phthorimaea operculella*, the larva of which attacks also tomato and tobacco plants, does occasional damage, especially in dry summers and when tubers are unnecessarily exposed. This season a species identified as *Phthorimaea melanoplintha* has attacked the tomato crops in most of the middle districts of the Dominion to such an extent as to be a serious financial loss in many instances. The injury is caused by the moth laying its eggs about the base of the plant; on hatching these become small caterpillars which tunnel the stem just above the ground, and are so numerous as to destroy it. As a natural result the top, which is then generally fully grown and loaded with immature fruit, wilts and withers.

The Entomologist, Plant Research Station, has taken up this new problem with a view to obtaining an effective means of control, but meanwhile growers should add arsenate of lead to the usual Bordeaux spray, and see that the base of the plant is well covered on each occasion when applying it. Control would also be increased by carefully destroying all potato, tomato, and tobacco plant refuse.

The subject is further referred to in the horticulture seasonal notes in this issue.

—*Horticulture Division.*

Sprayed Weeds eaten by Sheep.—Stinging nettles sprayed with a 5-per-cent. solution of sodium chlorate on a Hawke's Bay farm recently were eaten right up by sheep, apparently after the nettles had withered, four days after spraying.

POWDERY MILDEW OF THE APPLE AND ITS CONTROL.

N. J. ADAMSON, Orchard Instructor, Hastings.

POWDERY mildew may be regarded as a major apple-tree disease throughout the whole of New Zealand, and in certain areas it ranks foremost in causing economic loss. Possibly Hawke's Bay and Central Otago orchards suffer more severely from this disease than orchards in the other main fruitgrowing districts.

Although powdery mildew may cause a direct loss by reducing the market value of the crop through russeting (as undoubtedly mildew is one cause of russeting), the greater loss is brought about by the general reduction of healthy leaf-area and consequent weakened growth following attack. Such a condition must necessarily reduce the size of fruit and the total weight of crop, and, in cases of severe attack, will weaken the tree to such an extent as to affect the following season's crop. Continuous mildew attack will prevent a tree from gaining its maximum size, and where infection is severe a final state of extreme debility is reached.

Powdery mildew flourishes under conditions which prevail in Hawke's Bay, and one may surmise that such conditions favour its development. Orchards, for the most part, are particularly well sheltered by thick poplar belts, enclosing small areas. Summer temperatures are high, humidity is low. Except in young trees, foliage lacks tone, due no doubt to the particular soil and climatic conditions; consequently there is less resistance to the disease than with trees growing on clay lands.

Varieties are not equally susceptible to attack. Perhaps the Jonathan is affected to the greatest extent, while other varieties of commercial value to suffer severely are Gravenstein, Lord Wolseley, Cox's Orange, Sturmer, Dunn's, Cleopatra, and Rome Beauty. The time of attack by the disease and its development coincide with the unfolding of the primary leaves, and continue throughout the whole of the growing period. It therefore follows that spraying designed to control the disease should begin at an early stage, and be followed through till the season ends. There is an apparent resistance by certain varieties, and a similar resistance may be produced by bringing about a healthier leaf-growth in susceptible varieties, or, if not actually a leaf more resistant to the disease, one that is more resistant to spray specifics which are particularly desirable in the control. There seems to be evidence of the use of potash salts producing a leaf of better tone, which is more resistant to spray injury, and which in consequence may be treated more effectively against mildew attack.

In suggesting a method of dealing with the disease where the trouble has existed for some time, it is not necessary to prescribe anything revolutionary in orchard practice. Methods which are quite orthodox will give satisfactory results.

In looking for a reason for the failure of many growers to combat this trouble, the writer has been confronted with several significant features in orchard-management which have an important bearing on

the subject. For quite a time there has been a prejudice against the use of lime-sulphur as a summer spray, and this has grown to the extent of eliminating the use of lime-sulphur from some orchards, and in many instances having this valuable specific replaced, after the blossoming period, with wettable sulphurs and sulphur pastes (all sublimed sulphurs) less toxic than lime-sulphur, and not giving results as desired. Possibly the prejudice against lime-sulphur arose from the repeated scorching of foliage in the summer through persisting in its use on trees already weakened through neglect earlier in the season, and perhaps in using a more concentrated lime-sulphur at too great a strength for the particular stage of growth.

Insufficient pruning and the injudicious extension and crowding of lateral growths leading to weakness has aggravated the trouble.

Cultivation and the general nutriment of the tree has an important bearing on the matter of leaf-development and counteracting the effects of mildew. Failure to attain something approaching the ideal in this regard, and the consequent weaker growth, results in mildew damage being more pronounced. In this connection the advent of the tractor, in facilitating orchard cultivation, has produced a considerable improvement in tree-growth, balancing to a large extent the ill-effects of mildew.

The method of combating the disease suggested by the foregoing remarks is a matter of sufficiently stimulating leaf-development and consequent tree-growth, by pruning, cultivation, and the use of protective sprays, including the use of lime-sulphur. There is no short cut to success in securing in apple-trees the perfectly healthy foliage of rich tone and the good tree-growth one may visualize as being ideal. It is a matter of persistent effort and good orchard management.

Pruning should be of sufficient severity to guarantee strong growth as a preliminary. A good thinning-out of the tree is particularly desirable, even to the extent of reducing the number of main limbs. Weak and diseased wood should be boldly removed, and extended lateral growths severely shortened and adequately spaced. In extreme cases one may go to the extent of almost skeletonizing a tree. On varieties, such as Sturmer, which have become heavily spurred, a heavy spur-pruning, in addition to thinning out of wood, is of undoubted benefit. One may hesitate to adopt sufficiently drastic treatment, as is necessary, regarding it as a sacrifice of the following season's crop. Rarely is there a sacrifice of crop under such circumstances, but often an improved yield results immediately through larger-sized fruit being produced.

Early and good cultivation is extremely important, and in this respect the introduction of the tractor, as already mentioned, has greatly assisted. The advantages of the use of heavier implements, particularly the double tractor disks, in securing a good tilth quickly, and subsequently in being able to take full advantage of cultivating after rains, is fully recognized. Where horses are still utilized autumn ploughing is of great assistance in facilitating the spring work and in securing the desirable tilth by the more tedious method.

Sufficient thinning of fruit to avoid overcropping is also important in maintaining good foliage.

Spraying must necessarily play a very important part in combating mildew and in reducing its effects to a minimum. A programme designed to shorten the interval between sprayings, particularly early in the season, will go a long way towards minimizing the initial infection. When such is satisfactorily accomplished the subsequent summer preventive treatment is more effective, as it may be carried out with less liability to scorch where lime-sulphur is used throughout. Frequently the period between the pre-blossom and post-blossom spray is abnormally long, allowing the disease to become fully established. Commencing with lime-sulphur, 1–15, at "greentip," followed by an application of 1–35 at "open-cluster," and 1–60 at full "pink," one may keep pace with the primary leaf development and afford it protection. When 50 per cent. of the petals are down lime-sulphur, 1–100, followed at ten to fourteen days interval with lime-sulphur at the same strength, will ensure sufficient protection. Subsequently one must be guided in the use of lime-sulphur by the strength of foliage secured. This, it may be recognized, is a programme for black-spot control, and is also effective in combating red mite, *therefore it is of considerable advantage if lime-sulphur can be continued till later with safety.*

Lime-sulphur should be used much weaker as the season progresses, especially if foliage is below normal vigour and if the lime-sulphur is highly concentrated, working down eventually to 1–180 to 1–200. Some judgment must necessarily be exercised in the later sprays in using lime-sulphur, taking into consideration the strength of foliage and diseases to combat. The interval between sprayings at this later stage may be extended to twenty-one days. One may often gain something by substituting a free sulphur spray when temperatures become high, possibly from late December on, in order to produce a slight toning up of foliage, but more particularly to avoid injury. Possibly a good deal of credit attributed to the use of proprietary brands of wettable sulphurs is due to the earlier treatment, carried out on the lines suggested here.

The value of the use of sulphur in a very much finer form than can be secured in the form of a sublimed sulphur is already proved, and the possibilities of securing a colloidal sulphur in commercial quantities may shortly bring about a considerable modification of present spraying recommendations, particularly in reducing the number of sprayings necessary during a season.

However, the use of a more effective spray which will tone up foliage in a marked degree can only be fully effective when supplemented by good treatment otherwise, and its use will in no way remove the necessity for stimulating growth by good cultivation, sufficient pruning, regulation of crop by thinning, and the use of fertilizers.

Ragwort Stem-boring Insect.—Specimens of stem-boring insects causing the death of ragwort plants, received by the Plant Research Station, have been identified by the Entomologist as the larvæ of *Homoeosoma vagella*, common throughout New Zealand, and referred to in this *Journal* for July, 1929, pages 15 and 16. The benefit that this insect might bring by destruction of ragwort is ordinarily restricted by the fact that it is itself controlled by parasites. The subject will be dealt with in an early issue of the *Journal*.

FARMERS' PASTURE COMPETITIONS.

NORTH TARAŇAKI RESULTS, 1930.

J. M. SMITH, Instructor in Agriculture, New Plymouth.

JUDGING of the North Taranaki pasture competition for 1930 was recently completed. Prior to this judging had been carried out chiefly by means of the point analyser, but owing to the time necessary to carry out this form of judging it was not possible to point-analyse the pastures in the past season. The judging was done by observation, and, although the same detail of cover and composition was not obtained by this means, the weaknesses of the pastures could be easily detected by eye and the positions in the competition accurately allocated.

The scale of points was as follows: Good grasses, 30; clovers, 25; inferior grasses, 5; freedom from weeds, 10; denseness of sward, 15; utilization, 15: total, 100. Thus the high-production elements of the pasture sward represented 55 points, while denseness of sward and utilization, two very important points in good pasture-management, represented 30 points. The awarding of points for inferior grasses may appear at the first glance to be wrong, but the principle followed was that it was better to have the ground covered by inferior grasses than to have a lot of bare ground or a high percentage of weeds. Those grasses which came under the classification of good grasses were perennial rye, timothy, cocksfoot, dogstail, paspalum, meadow foxtail, Poa pratensis, Poa trivialis, and Italian rye, while the inferior species included Yorkshire fog (which must be considered by far the most important grass in this group), sweet vernal, brown-top, danthonia, &c.

The total number of entries judged was 49, located as follows: Inglewood, 17; Huirangi, 11; Urenui, 9; Kaimata, 6; Lepperton, 4; and Tikorangi, 2. Unlike the crop and ensilage competitions, the judging of the pastures comes at an extremely busy period of the year, and for this reason many farmers are unable to give much time to accompanying the judges on their rounds; but it is gratifying to see how many do turn out despite this pressure, and competitors are always on the spot to see their own entries judged, and to discuss the pasture and ways and means of improving it with the judges.

Generally speaking, the standard of the pastures judged was high, but it must be remembered that probably the pastures entered are among the best in each district, so that the average of those inspected would probably be a great deal better than the average of all pastures in North Taranaki. However, the general weaknesses of those pastures judged will represent the weaknesses in North Taranaki pastures as a whole, though perhaps to a lesser extent.

In order to get down to a basis of judging, one must have an ideal pasture standard, and it is the considered opinion of the Agriculture Department's grassland experts that the sward carrying as its dominant species perennial rye-grass and white clover is the pasture par excellence for butterfat production. Of course, it is necessary to have also other grasses and clovers to suit local conditions of seasonal growth, &c., but where perennial rye-grass and white clover are holding their own it is

an indication that conditions generally—fertility, moisture, shading, grazing, &c.—are correct for the establishment of a high-production sward.

In Taranaki, generally speaking, there is little or no trouble in getting white clover well established; in fact, there are times when there is an inclination for this clover to dominate the sward, which is not a good thing, as a balance between grasses and clovers should be kept. One of the greatest weaknesses of Taranaki grasslands, however, is the relatively small amount of rye-grass present. Occasionally perhaps this may be due to lack of fertility, but in most cases the trouble may be traced to the sowing of a poor temporary strain of rye-grass, which has gone out despite the best care and attention. Rye is one of our best butterfat grasses, and a dairying pasture poor in rye-grass is often poor in production. Unfortunately, the bulk of the rye-grass sown in Taranaki in the past appears to have been of a temporary strain, although bought in good faith as truly perennial. With the system of certification, under which none but rye-grass of a permanent nature are certified, the position should gradually right itself, but it will mean expensive seed for a year or so.

One point requires watching in connection with certified seed, and that is its germination. Because a line of seed has been certified this is taken by some to mean that the seed is right in every way; but the certification is only in connection with the factor of permanence, and as farmers are paying a fair price for the seed they should make sure that the germination is right.

Cocksfoot does not play a big part in the average Taranaki sward. Some pastures inspected were fairly strong in this grass, but the greatest number just had only a small amount through them. Cocksfoot is an excellent grass and one that gives good summer feed, and should certainly be encouraged. Timothy does not show up very strongly in general. With the ample local rainfall one would expect to see more of it, although the soil-type is not of the best for high timothy production. In one instance a strong growth of meadow foxtail was noticed, but the average Taranaki country does not hold this grass very well. Crested dogstail is fairly strong, generally speaking, and is a good grass in summer; besides growing a good deal of feed it forms a close and continuous sward, which is a very desirable feature.

A grass that might be given wider consideration in Taranaki is paspalum. The local feeling against this species is not so strong as it was, and quite a number of the pastures judged contained a quantity of paspalum. In this province there is little danger of paspalum taking charge, as the climate is so favourable for the other grasses that they compete effectively with paspalum and keep it in its place. In Taranaki paspalum appears to be developing a longer growing-period; whereas a few years ago one did not expect to get much from it until after the New Year, now it grows quite a considerable amount of feed in October and November. Very little Poa trivialis was noticed, but Poa pratensis (or couch) occupies too much of the pastures.

As far as the clovers are concerned, as previously mentioned, no trouble is experienced in getting a good sole of white clover. Red clover or cow-grass, on the other hand, is very weak, on account of the temporary nature of most of the local strains. One pasture judged

had an exceptionally fine sole of subterranean clover, and this was throwing quite an amount of feed. This is a clover that could be more widely grown to advantage. Lotus major is too common in the pastures of the district, and its place should be occupied to a greater extent by white clover.

Of the inferior grasses sweet vernal is by far the worst, and this species occupies an immense amount of the grassland. The typical Taranaki light soil apparently suits it, and it appears to establish itself very quickly before the better grasses are able to assert themselves, and unless at that time the fertility is extremely good these better species find it a very uphill fight against vernal. It is debatable whether Yorkshire fog should not be included in the list of good grasses for the district. Some pastures are full of fog, and yet are high producing, so that there must be merit in this grass, providing stock will eat it. Other inferior grasses as far as dairying is concerned, which were observed, were brown-top, ratstail, and danthonia, but these were in small quantities.

The denseness of the sward (or cover) was not all that could be desired, but generally speaking it was quite good. It is obvious that an open turf must be a low-production one.

The apparent weaknesses, then, are lack of rye-grass; excess of sweet vernal and flat weeds, such as rib-grass, catsear, &c.; and openness of turf. Just how can farmers overcome these weaknesses? In a few cases the pastures may be beyond redemption, or have gone back to such an extent that treatment, other than renewal, may be economically unsound. In many other cases if it were possible to introduce, say, a little rye-grass in place of vernal and weeds the pasture would be satisfactory, and the matter of surface-sowing is one that should be given more thought. Successful surface-sowing is dependent upon three factors, one of which we have no control over. These are (1) opening up of the turf sufficiently to get the seed covered, (2) the standard of fertility of the soil, and (3) the weather conditions following sowing. The first may be brought about by disking several times; it is impossible in most cases to prepare a satisfactory seed-bed with the harrows alone. The standard of fertility may be reached by the liberal use of manure with the seed. The weather, however, must be left to Providence. Top-dressing is, of course, the greatest weapon one can wield in bringing a pasture back or up to high production, providing that the grasses are there. Harrowing is a further weapon to force the pastures along, and it is gratifying to have to record that out of the fifty entries only two pastures had not been harrowed during the season.

Another pleasing feature of the 1930 competition was the utilization of the pasture growth. Poor utilization is bad, because the money spent in manure, seed, labour, &c., is being partially wasted. We have almost reached the stage of growing two blades of grass where one grew before, but the cry now is to fully utilize those two blades.

For the year under review the competition was divided into two classes—one for those pastures treated as solely dairying pastures, and the other for those grazed by dry cattle. In this latter class there was only one entry, that of S. Topless, Urenui, which pasture scored 90 points. Detailed results for the dairying pasture entries judged are given in the table which follows.

Results of North Taranaki Pasture Competition, 1930.

No.	Competitor.	Locality.	Area.	Age.	Top-dressing.	Harrowing.	Points Awarded.						
							Good Grasses. (30)	Clovers. (25)	Inferior Grasses. (5)	Freedom from Weeds. (10)	Denseness of Sward. (15)	Utilization. (15)	Total. (100)
			Acres.	Years.									
1	C. Macinder	Huirangi ..	10	12	1929: Slag, 3 cwt.; potash, 1 cwt.; sulphate of ammonia, ½ cwt. 1930: Slag, 3 cwt.	Tripod three times	28	22	2	8	14	15	89
2	F. Bracegirdle	Kaimata ..	5½	12	1929: Slag, 4½ cwt. 1930: Slag, 4½ cwt.; sulphate of potash, ½ cwt.	"Taylor" harrow twice	27	23	3	8	14	13	88
3	J. H. Paulger	Tikorangi ..	3½	7	1929: Gafsa phosphate, 4 cwt.; super, 2 cwt.; potash, 1 cwt. 1930: Super, 2 cwt.; potash, 2 cwt.; nitrate of soda, ½ cwt.	Tripod twelve times	26	24	2	7	13	15	87
4	F. S. Burson	Inglewood..	4	4	1929: Slag, 3½ cwt. 1930: Slag, 2½ cwt.; sulphate of ammonia, 2½ cwt.	Tripod three times	27	23	3	7	13	14	87
5	B. F. Fabish	Inglewood..	7½	4	1929: Slag, 3 cwt. 1930: Super, 3 cwt.; sulphate of ammonia, 1 cwt.	Tripod once ..	27	22	3	7	13	14	86
6	A. Morton ..	Inglewood..	3	7	1929: Slag, 4 cwt. 1930: Slag, 4 cwt. ..	Nil	27	22	3	6	13	14	85
7	W. Sutton ..	Huirangi ..	8	10	1929: Slag, 2½ cwt. 1930: Slag, and African phosphate, 3 cwt.	Tripod five times ..	24	24	3	7	14	13	85
8	J. Poletti ..	Huirangi ..	4½	12	1929: Slag, 3 cwt. 1930: Super, 3 cwt. ..	Tripod twice ..	24	23	3	6	13	15	84
9	M. W. Giddy	Huirangi ..	6½	12	1929: Slag, 3 cwt. 1930: Slag, 3 cwt. ..	Tripod three times..	23	23	4	6	13	14	83
10	R. B. Sutton	Inglewood..	7	6	1929: Super, 3 cwt. 1930: Slag, 3 cwt. ..	Tripod twice ..	25	20	4	6	14	14	83
11	F. J. Shute	Inglewood..	11	14	1929: Slag, 2 cwt.; potash, 1 cwt. 1930: African phosphate, 2 cwt.; potash, 1 cwt.	Chain once ..	26	22	3	6	12	14	83
12	J. Mooney ..	Urenui ..	8	20	1929: Slag, 3 cwt. 1930: Slag, 3 cwt. ..	"Whakatane" harrow three times	26	23	2	6	12	14	83
13	H. A. Leach	Lepperton..	7	7	1929: Slag, 3½ cwt. 1930: Super, 3 cwt.; potash, ½ cwt.; sulphate of ammonia, ½ cwt.; lime, 5 cwt.	Tine once ..	25	23	4	6	12	13	83
14	J. Dobson ..	Kaimata ..	9	15	1929: Slag, 3½ cwt. 1930: Slag, 3½ cwt. ..	Tripod twice ..	25	23	4	5	13	12	82
15	H. R. Marsh	Inglewood..	3	7	1929: Slag, 3 cwt. 1930: Basic super, 3 cwt.	Tripod twice ..	25	21	4	6	12	14	82
16	A. B. Allen	Inglewood..	5	5	1929: Slag, 2½ cwt. 1930: Slag, 2½ cwt. ..	Tripod twice ..	25	21	4	6	13	13	82

North Taranaki Pasture Competition—continued.

No.	Competitor.	Locality.	Area.	Age.	Top-dressing.	Harrowing.	Points Awarded.						
							Good Grasses. (30)	Clovers. (25)	Inferior Grasses. (5)	Freedom from Weeds. (10)	Denseness of Sward. (15)	Utilization. (15)	Total. (100)
			Acres.	Years.									
17	J. N. Blyde ..	Lepperton ..	4	10	1929 : Slag, 3 cwt. ; lime, 10 cwt. 1930 : Nitrophoska, 2 cwt.	Tripod twice ..	25	23	3	5	11	15	82
18	T. Hine ..	Tikorangi ..	4	15	1929 : Slag, 4 cwt. 1930 : Slag, 4 cwt. ; sulphate of ammonia, 1 cwt.	Tine twice ..	26	22	3	6	13	12	82
19	O. J. Dodunski	Inglewood ..	..	..	..	..	26	22	4	6	11	12	81
20	D. L. Tate ..	Urenui ..	6	20	1929 : Slag, 2½ cwt. ; sulphate of ammonia, 1 cwt. 1930 : African phosphate and super, 5 cwt. (two dressings)	Tripod three times	25	22	3	6	12	13	81
21	H. E. Blyde	Lepperton ..	5	7	1929 : Slag, 3 cwt. 1930 : Slag, 3 cwt. ..	"Perfect" harrow three times	23	23	4	5	12	14	81
22	R. Andrews ..	Urenui ..	7	3½	1929 : Slag, 3½ cwt. 1930 : Basic super, 3½ cwt.	Tripod once ..	26	21	2	6	11	14	80
23	A. E. Burwell	Kaimata ..	4½	9	1929 : Slag, 3 cwt. 1930 : Ammoniated super, 2½ cwt.	Tripod every two months	24	21	3	6	12	14	80
24	W. Hall ..	Huirangi ..	5	15	1929 : Basic super, 3 cwt. 1930 : Slag, 3 cwt.	Nil	27	21	2	6	12	12	80
25	F. J. Webb	Inglewood ..	3	10	1929 : Slag, 3 cwt. 1930 : Basic super, 3 cwt.	Tripod once ..	22	21	4	5	13	14	79
26	Osborne and Andrews	Huirangi ..	5	10	1929 : Slag, 3 cwt. 1930 : Slag, 3 cwt. ..	"Taylor" twice ..	25	22	3	5	11	13	79
27	R. Luxton ..	Urenui ..	5	7	1929 : Slag, 3 cwt. 1930 : Slag, 3 cwt. ; sulphate of ammonia, 1½ cwt.	Heavy tripod three times	23	22	4	6	11	13	79
28	J. Klenner ..	Kaimata ..	5	6	1929 : Basic super, 3 cwt. 1930 : African phosphate, 3 cwt.	Tripod four times ..	23	21	4	5	12	13	78
29	J. H. Shute	Inglewood ..	4	20	1929 : Slag, 3 cwt. 1930 : Super, 3 cwt. ; sulphate of ammonia, 1½ cwt.	"Whakatane" twice and chains once	22	21	4	5	12	14	78
30	A. W. Yeates	Inglewood ..	4	7	1929 : Super, 2 cwt. ; potash, 1 cwt. 1930 : Super, 2 cwt. ; potash, 1 cwt.	Chains twice ..	24	20	4	4	12	14	78
31	Rust and Butler	Inglewood ..	11	15	1929 : Super, 3 cwt. 1930 : Super and bone, 3 cwt.	"Taylor" once ..	24	19	3	6	12	13	77
32	L. Jury ..	Huirangi ..	20	4	1929 : Slag, 3¼ cwt. 1930 : Slag, 3¼ cwt. ..	Tripod once ..	21	23	4	5	12	12	77

North Taranaki Pasture Competition—continued.

No.	Competitor.	Locality.	Area.	Age.	Top-dressing.	Harrowing.	Points Awarded.						
							Good Grasses. (30)	Clovers. (25)	Inferior Grasses. (5)	Freedom from Weeds. (10)	Denseness of Sward. (15)	Utilization. (15)	Total. (100)
			Acres.	Years.									
33	W. Nichol ..	Lepperton..	11½	40	1929: Not known. 1930: Super, 2½ cwt. ..	Tripod once ..	20	22	4	4	12	15	77
34	H. Jones ..	Kaimata ..	5	10	1929: Slag, 2 cwt; super, 2 cwt. 1930: Super, 2 cwt.	Nil	20	22	4	4	12	14	76
35	R. Longstaff	Inglewood..	6	20	1929: Slag, 3 cwt. 1930: Slag, 3 cwt.; sulphate of ammonia, 1¼ cwt.	"Perfect" four times	22	20	4	4	12	14	76
36	A. H. Bennett	Inglewood..	6	13	1929: Super and African phosphate, 3 cwt. 1930: Slag, 3 cwt.	Tripod twice ..	22	20	3	5	12	14	76
37	B. Budden ..	Huirangi ..	13	9	1929: Slag, 3 cwt. 1930: Super, 1½ cwt. ..	Tripod four times ..	21	20	4	5	12	14	76
38	J. F. Phillips	Urenui ..	5½	15	1929: Slag, 2½ cwt. 1930: Slag, 3 cwt. ..	Tripod once ..	20	21	4	5	11	14	75
39	J. Thomason	Inglewood..	6	5	1929: Slag, 3 cwt. 1930: Slag, 3 cwt.; potash, 40 lb.; super, 2 cwt.; sulphate of ammonia, 50 lb.; and lime	Tripod each month	22	20	4	4	11	14	75
40	C. Honeyfield	Urenui ..	9	Old	1929: Slag, 3 cwt. 1930: Slag, 3 cwt. ..	"Whakatane" once	21	20	4	4	11	14	74
41	G. Salway ..	Urenui ..	..	..	..	..	22	20	4	4	10	14	74
42	P. Honnor ..	Huirangi ..	6	13	1929: Super, 3 cwt. 1930: Super, 3 cwt. ..	Tripod twice ..	19	21	4	4	11	14	73
43	F. Harford ..	Huirangi ..	7	8	1929: Slag, 3 cwt. 1930: Super, 3 cwt. ..	"Whakatane" three times	20	20	4	6	13	10	73
44	F. J. Andrews	Huirangi ..	5	45	1929: Super, 3 cwt. 1930: African phosphate and basic super, 3 cwt.	Tripod twice ..	20	20	4	5	10	13	72
45	W. J. Guilford	Inglewood..	..	..	..	..	19	22	4	3	11	13	72
46	R. Johnston	Urenui ..	..	..	..	..	20	20	4	4	10	14	72
47	E. T. Gyde ..	Inglewood..	5	6	1929: Slag, 3 cwt. 1930: Slag, 3 cwt. ..	Chains once ..	18	20	5	4	10	14	71
48	R. Field ..	Kaimata ..	4	6	1929: Super, 2½ cwt. 1930: Nil	Nil	17	15	4	4	10	14	64

NOTE.—In all pastures detailed in this table the grazing was by dairy cows, except in No. 48, where both sheep and cows were grazed.

NITROGEN TOP-DRESSING OF WHEAT.

EXPERIMENT WITH VARIOUS FORMS OF FERTILIZER AT DIFFERENT TIMES OF APPLICATION, SEASON 1929–30.

A. Y. MONTGOMERY, late Assistant Crop Experimentalist, Fields Division, Department of Agriculture.

THE experiment here recorded was planned by Mr. A. W. Hudson, Crop Experimentalist, Plant Research Station, and forms a part of a comprehensive scheme of wheat-manuring experiments in Canterbury. The sowing, application of manures, observations, cutting, and threshing were conducted by the writer, with the assistance of the Fields Division Staff, Christchurch, under the control of Mr. R. McGillivray, Fields Superintendent for Canterbury.

Previous experiments conducted by the Department of Agriculture in all the chief grain-growing areas of Canterbury on the manuring of wheat with nitrate of soda and sulphate of ammonia had shown that the top-dressing of these soluble nitrogenous fertilizers on wheat would give a very handsome profit. (See this *Journal*, "Wheat-manuring Experiments in Canterbury: Summary of Six Season's Research and Recommendations to Farmers," April, 1929.) Since these experiments had demonstrated that such fertilizers were certain to play a very important part in wheat-production in Canterbury, it was considered advisable to obtain information on the effects of various forms of soluble nitrogenous fertilizers in relation to the time of application and the stage of growth of the wheat plant at the time of application. With this object a co-operative experiment was set up on the farm of Mr. F. W. Carpenter, at Prebbleton, near Christchurch, in 1929.

PARTICULARS OF THE EXPERIMENT.

The experimental plots were sown on 5th and 6th June, 1929, a good strike being obtained. Soil: Medium silty loam; good cropping land. Previous crops: Wheat in 1927-28, rape in 1928-29. Variety: Solid-straw Tuscan, 118 lb. per acre. (This seeding was about 20 lb. heavier than usually sown owing to the fact that the sample contained some broken grains; the sample was good otherwise.) The experiment, before top-dressing with nitrogen compounds, consisted of 108 plots, each 340 ft. long and 7 coulter-rows wide (coulter rows 7 in. apart) with 14-in. spacing between plots.

As a basal manuring the plots were all treated with superphosphate (44 -46 tricalcic phosphate) at 180 lb. per acre at time of sowing. The increases, therefore, due to use of the nitrogen compounds are additional to any increase due to superphosphate. On this farm the average crop increase over a period of five years due to the application of 1 cwt. of super has been 4·5 bushels per acre.

Treatments of nitrogenous manures per acre were as follows:—

Plot 1: No nitrogen (control).
Plot 2: Nitrate of soda (15·5 per cent. N.), 149 lb.
Plot 3: Sulphate of ammonia (20·6 per cent. N.), 112 lb.
Plot 4: Calcium cyanamide (19 per cent. N.), 121 lb.
Plot 5: Urea (= 46 per cent. N.), 50·5 lb.
Plot 6: Calnitro (20·6 per cent. N.), 112 lb.

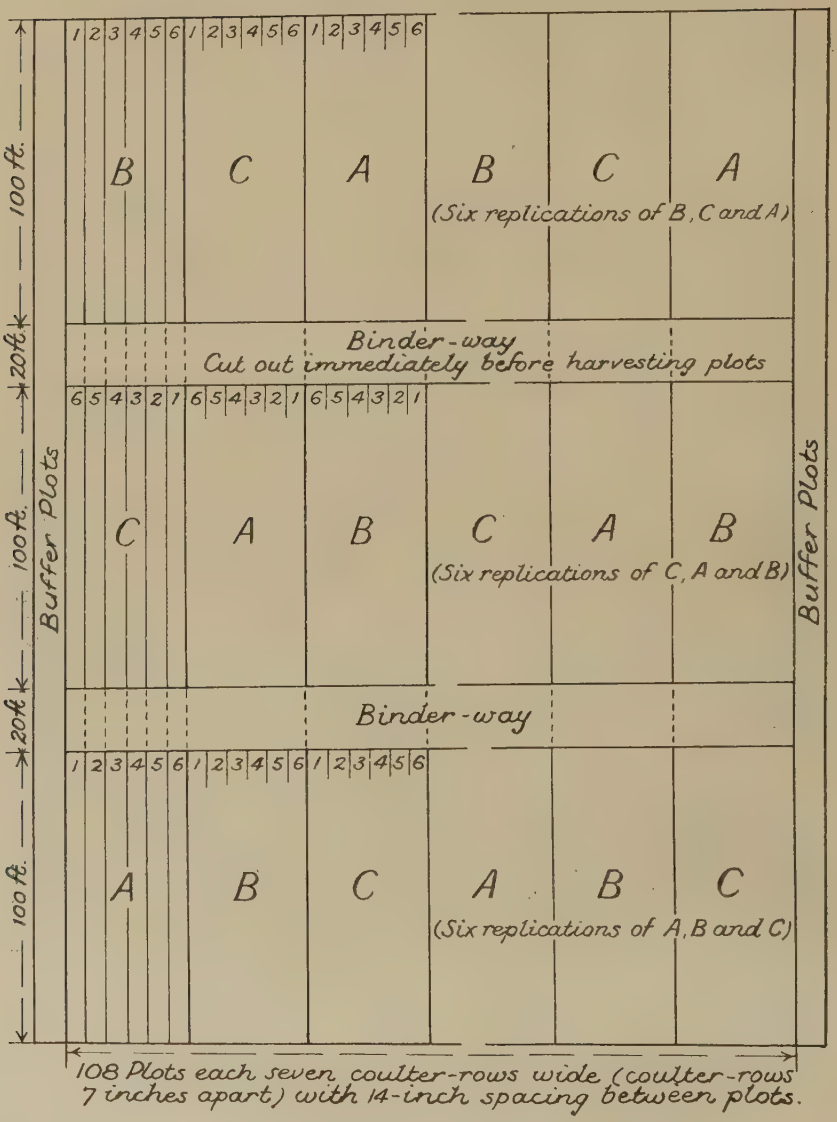
1 2 3 4 5 6 1 2 3 4 5 6 1 2 3 4 5 6
B C A B C A
(Six replications of B, C and A)
100 ft.
20 ft.
Binder-way
Cut out immediately before harvesting plots
6 5 4 3 2 1 6 5 4 3 2 1 6 5 4 3 2 1
C A B C A B
(Six replications of C, A and B)
Buffer Plots
100 ft.
20 ft.
Binder-way
1 2 3 4 5 6 1 2 3 4 5 6 1 2 3 4 5 6
A B C A B C
(Six replications of A, B and C)
100 ft.
Buffer Plots
108 Plots each seven coulter-rows wide (coulter-rows 7 inches apart) with 14-inch spacing between plots.

FIG. I. PLAN SHOWING ARRANGEMENT OF PLOTS.

Before top-dressing with the nitrogenous fertilizers began the experiment consisted of 108 plots each 340 ft. long and seven coulter-rows wide (each coulter-row 7 in. apart), with 14 in. spacing between plots. For method of sowing similar plots see this *Journal* for July, 1926, p. 6. The plots were then divided as seen in plan into three sectors of 100 ft. each, with 20 ft. between sectors. This 20 ft. was not top-dressed with nitrogen, and was cut out at harvest-time before harvesting the nitrogen-treated plots (see photo, Fig. 2).

On the plan "A" represents blocks top-dressed in August, "B" blocks top-dressed in September, and "C" blocks top-dressed in October. The individual treatments 1 to 6 are indicated in the text.

Plots 2 to 6 inclusive received exactly the same quantity of *nitrogen* per acre. These manures were mixed with a sufficient quantity of sawdust to allow of easy uniform application by hand, each plot receiving the same amount of sawdust. The manures were hand applied to the appropriate plots (see plan) on the following dates: Blocks A, 19th August; Blocks B, 21st September; Blocks C, 19th October.

In order to minimize differences due to soil variation, &c., the plots were put down across the direction of the ploughing. Furthermore, as seen in the plan, the order of the individual plots (1 to 6) was different in the mid sector from that in the two end sectors. The monthly applications (A, B, and C) were also "staggered" in such a way that the effect of soil differences was minimized.

FIG. 2. CUTTING OUT ONE OF THE BINDER-WAYS.

The photo shows the first cut being made. The sheaves, which were delivered into the standing crop by the reaper-and-binder, were subsequently thrown back on to the cut strip and carted away.

Effect of Nitrogen Treatments during Growing-period.

The following section of this article deals only with the effects of the applied fertilizers on the development, colour, and general appearance of the plots during the growing-period. Those readers who are more particularly interested in the *results* could turn directly to the yield data and comments thereon.

NOTES ON AUGUST APPLICATION.

At this date (19th August) the crop had not yet received its spring harrowing. The crop was 1in. to 2in. high. The manures were applied by hand at the appropriate quantities. There was no wind, so that no blowing of manure from one plot to the next occurred. Heavy rain fell

the following night, the manure being thus well washed into the soil and off the leaves of the wheat plants. (This is an important consideration in respect of calcium cyanamide, which tends to "burn" the leaf wherever it touches.)

The physical condition of the manures was as follows:—

(1) Nitrate of soda was fairly moist, and could have been applied with the drill only with difficulty. When spread on the floor of a loft to dry it became wetter.

(2) Calcium cyanamide, put up for sale in iron drums, perfectly dry, would sow from a drill with ease. This manure, however, has a very trying effect on the eyes and is decidedly unpleasant to handle. An oiled, and what is claimed to be an improved, form, is now coming on the market. The oiled form is said to make the manure easier to handle.

(3) Sulphate of ammonia was in much better condition than the nitrate of soda. Rather damp, but could have been applied with a drill. When spread out in the loft it dried considerably, making it easy to apply with a drill.

(4) Urea was set in one solid lump in the bag—very hard to crush. When broken was quite dry, and would have been easy to sow through a drill.

(5) Calnitro was very wet, almost slushy, and would have been impossible to sow through a drill. When spread to dry it became wetter.

SEPTEMBER APPLICATION.

This application was made as per plan on 21st September, when the crop was 2 in. to 3 in. high. In accordance with normal farm practice, the crop was fed down and harrowed between the August and September applications. None of the nitrogen manures of August application showed up at this stage. The absence of any visible effect was probably due to the feeding-off.

The weather was calm at time of dressing, and the paddock wet on surface after recent rains. All the fertilizers could have been applied with a drill except Calnitro. Urea had to be broken out of the bag, but was dry.

OCTOBER APPLICATION.

This dressing was made on 19th October, the crop at this date being 4 in. to 5 in. high, and weather fine and dry.

The effect of the August and September applications could be plainly seen. The nitrogen plots showed to advantage, being dark green and about 5 in. in height, whereas the controls were of a much lighter colour and about 4 in. high. The nitrogen plots were all fairly similar in appearance, except that the calcium cyanamide (September application) did not seem quite so good as the others, and showed yellowing of lower leaves.

All the fertilizers, except Calnitro, were fine and dry, and could easily have been applied with a drill.

OBSERVATIONS ON GROWTH AND APPEARANCES OF PLOTS AT VARIOUS STAGES AFTER DRESSINGS.

1ST NOVEMBER, 1929.

August application: Plots of all forms of nitrogen very similar in appearance. Plants greener, more tillered, and better developed than control, and 2 in. taller (sulphate of ammonia plot about 15 in. high at this time). Control was noticeably much more open in appearance, yellower, and shorter. Best plots Urea and sulphate of ammonia, followed by calcium cyanamide, nitrate of soda, and Calnitro very closely.

September application: Control plots showing worst-developed plants; yellow, comparatively stunted, with much less leaf than all others. All

nitrogen plots very much alike. Calcium cyanamide better than control, but bottom leaves yellowed (burning) and plants not so well grown as rest. Nitrate of soda best plot, followed closely by sulphate of ammonia, Urea, and Calnitro, in that order.

October application: Control worst plot; plants shorter and yellower, with less leaf. Calcium cyanamide showed yellowing of lower leaves, but was better grown than control. All rest now showing effects of nitrogen well. Nitrate of soda best-grown plot, followed closely by sulphate of ammonia, Urea, and Calnitro, which were similar in development. Nitrate of soda plot 1 in. to 2 in. higher than control.

NOTE.—The August-dressed plots were better developed than September plots, and September better developed than October. About 1 in. in height between respective treatments.

21ST NOVEMBER, 1929.

August application: Control was very noticeably poorer grown, with much less leaf, yellower, and 2 in. shorter than nitrogen plots. All nitrogen plots much better than controls; difference among nitrogen plots themselves small. Urea best plot; then followed nitrate of soda, sulphate of ammonia, calcium cyanamide in that order; Calnitro was the worst plot.

September application: Control was very backward relatively, showing spindly growth and yellow colour. Nitrate of soda plots showed best development of leaf, deepest green, and tallest. Sulphate of ammonia, calcium cyanamide, Urea, and Calnitro all equal in appearance.

October application: Control relatively yellow and stunted; nitrate of soda tallest, greenest, and thickest; then plots run in descending order of development in height and colour from Calnitro, to sulphate of ammonia, to Urea; calcium cyanamide was the worst plot.

OBSERVATIONS ON GROWTH AND APPEARANCE IMMEDIATELY BEFORE CUTTING, 4TH FEBRUARY, 1930.

The crop was a fairly good one generally, but differences were observed according to the following notes:—

Blocks A—August application: Control was the poorest plot, being thinnest and shortest. Nitrate of soda was the best plot, being thickest and ripest, with every indication of a heavier yield. (NOTE.—The controls, which were relatively least ripe, were quite ready to cut, the whole experiment being cut some days after Mr. Carpenter's own crop, which was sown after the experiment.) All other nitrogen plots very equal in appearance. All nitrogen plots about the same tallness; perhaps calcium cyanamide a little inferior in appearance.

Blocks B—September application: Control poorest, shortest, least ripe, and thinnest. Nitrate of soda was the best plot; next best, Urea; then sulphate of ammonia and Calnitro, which were similar in appearance. Calcium cyanamide was worst of nitrogen plots but better than control.

Blocks C—October application: Control relatively greener and thinner, with poorer finished heads, shorter by 1 in. than nitrate of soda. Nitrate of soda was the best plot, being thickest and ripest, and having best finished heads, with the same tallness as sulphate of ammonia. Calcium cyanamide was better than control, but the worst of the nitrogen plots. Sulphate of ammonia and Calnitro were the second best plots and on a par. Urea was inferior to sulphate of ammonia.

COMMENTS ON RESULTS IN TABLE OF YIELDS.

In evaluating the increases due to manuring shown in Table 1 (next page) the fertilizers are quoted at ex-store prices to farmers. A bushel of Solid-straw Tuscan is worth about 5s. 9d., but 9d. per bushel is deducted for threshing and bagging costs, making each additional bushel of wheat,

Table 1.—Summary of Yields.

Each yield is the average of eighteen plots. The yield figures in brackets are the increases over the controls at the top of the same column.

Treatments per Acre.	Yields in Bushels per Acre.		
	August Application.	September Application.	October Application.
No nitrogen (control)	37·8	37·9	38·1
Nitrate of soda, 149 lb.	46·3 (8·5)	48·7 (10·8)	48·8 (10·7)
Sulphate of ammonia, 112 lb. ..	47·1 (9·3)	45·3 (7·4)	43·6 (5·5)
Urea, 50·5 lb.	46·4 (8·6)	45·2 (7·3)	42·7 (4·6)
Calcium cyanamide, 121 lb. ..	45·4 (7·6)	39·7 (1·8)	41·4 (3·3)
Calnitro, 112 lb.	44·4 (6·6)	44·8 (6·9)	43·7 (5·6)

NOTE.—A difference is said to be "significant" when the computed odds are greater than 30 : 1 in favour of its being a real difference and not due to chance variation.

due to manuring, worth 5s. net. The cost of the fertilizers is then deducted as shown below.

(1) "*No-nitrogen*" (control) plots showed a significantly smaller yield than all the nitrogen-treated plots. The control plots as shown do not differ significantly among themselves, showing that the effects of soil variations were overcome by the method of arranging the plots.

(2) *Nitrate of Soda.*—The September and October applications were significantly better than the August application. So far as this one experiment may be taken as a guide, the best time to apply nitrate of soda is September or October.

The September and October applications of nitrate of soda gave the highest yields of all the applied fertilizers—increases of 10·8 and 10·7 bushels per acre respectively over their controls. Nitrate of soda costs 16s. per cwt., thus 149 lb. would cost 21s. The profit in this case is therefore 10·8 bushels at 5s. per bushel = 54s., minus 21s. = 33s. per acre. A profit of £1 13s. per acre in one crop cannot be ignored by any practical farmer who conducts his farming as a business.

(3) *Sulphate of Ammonia.*—The August application was the best, being significantly higher than the September one, which was in turn better than the October application. The August application of sulphate of ammonia was barely significantly better than the August application of nitrate of soda.

The August application of sulphate of ammonia is the third highest yield, being 9·3 bushels per acre better than the corresponding control. Since sulphate of ammonia costs 13s. per cwt. the profit in this case amounts to £1 13s. 6d. per acre. The profit per acre is the same as from the best nitrate of soda application, but sulphate of ammonia has the added advantage of being more easily applied in moist weather.

(4) *Urea.*—According to the results of this experiment early application of Urea is desirable. The August application was significantly better than the September one, and the September significantly better than October application.

The August application is the fourth highest yield, being 8·6 bushels per acre better than the corresponding control. Urea costs 28s. 3d. per cwt. ; 50·5 lb. costs 12s. 9d. ; 8·6 bushels at 5s. are worth 43s. ; therefore

the profit per acre is 43s. less 12s. 9d. = 30s. 3d. This profit of £1 10s. 3d. is very little lower than that from sulphate of ammonia and nitrate of soda.

(5) *Calcium Cyanamide.*—August was the best month to apply this fertilizer. The August application was significantly better than the September one, which, however, does not differ *significantly* from the October application.

The August application was 7·6 bushels per acre better than the corresponding control. Calcium cyanamide costs 12s. 4d. per cwt. and 121 lb. was applied; 7·6 bushels at 5s. per bushel = 38s.; profit per acre = 38s. less 13s. 4d. = 24s. 8d.

(6) *Calnitro.*—The August and September applications of Calnitro are about on a par, both being better than the October application.

Calnitro gave the lowest increase, being only 6·9 bushels better than the corresponding controls. Calnitro costs 15s. 9d. per cwt. Since 6·9 bushels are worth 34s. 6d. the profit per acre = 34s. 6d. less 15s. 9d. = 18s. 9d. per acre.

Conclusions regarding Nitrogenous Manures.

No absolutely definite conclusion of a *general* nature should be drawn from any single agricultural experiment. Only when the foregoing results have been confirmed by many other similar experiments in other seasons and under varying soil and climatic conditions can an accurate generalization be made. Nevertheless, this experiment is of undoubted value as a guide to future experimentation and farm practice. Following are the more important results and indications:—

(1) Sulphate of ammonia is probably the best form of nitrogen to apply. It showed the same profit per acre as nitrate of soda, but it is easier to apply through a drill. It should be applied in August, or early September in late districts, when the crop is 1 in. to 2 in. high.

(2) If nitrate of soda is used it should be applied in September or October, when the crop is from 2 in. to 5 in. high.

(3) Urea gave slightly less profit per acre than sulphate of ammonia and nitrate of soda, but suffered in comparison with sulphate of ammonia, particularly on account of its physical condition and the difficulty of sowing small quantities with accuracy through a drill.

(4) Calcium cyanamide showed less profit per acre than the foregoing fertilizers. The best time of application of those tried was August. When applied in August the tendency to burn the wheat plant was lessened. In this case this was probably due to the rain which fell the night after application. Calcium cyanamide, in the form in which it has been marketed up to the present, has a serious drawback in its irritating effect on the eyes, skin, &c., of the operator, but an improved "oiled" sample is now on the market, and, it is claimed, will effectively overcome this defect.

(5) Calnitro showed the lowest profit per acre, and was impossible to sow through a drill on account of its wet condition.

Milling and Baking Tests of Wheat from some of the Treatments.

The laboratory of the New Zealand Wheat Research Institute, Christchurch, kindly carried out milling and baking tests of the samples indicated in its report, the results of which are set out in Table 2 (next page).

Table 2.

Manurial Treatment.	Percentage of Protein.	Percentage Yield of Flour.	Baking Score: Points out of Possible of 50.
No nitrogen	10·1	67·1	32
Nitrate of soda (August application) ..	10·1	67·7	33
Sulphate of ammonia (August application) ..	10·1	69·2	32
Nitrate of soda (September application) ..	9·6	68·3	33
Sulphate of ammonia (September application)	10·1	67·6	34
Nitrate of soda (October application) ..	9·9	69·0	35
Sulphate of ammonia (October application)	10·3	68·6	36

NOTE,—Points under "Baking Score" are awarded for flavour, crumb colour, general appearance, pile, texture, and bloom.

"There is little difference," adds the report, "between the various treatments. All values are practically within the limits of error introduced by sampling and personal error in determining the values."

RAINFALL FROM MAY TO FEBRUARY INCLUSIVE.

The following rainfall records were kindly supplied by the meteorological recording station at Canterbury Agricultural College, Lincoln. The station is about three miles from the field on which the experiment was conducted.

Table 3.

Month.	Rainfall.	Number of Days on which Rain fell.	Month.	Rainfall.	Number of Days on which Rain fell.
	Inches.			Inches.	
May, 1929	0·61	6	October, 1929	0·13	4
June, ,,	4·32	11	November, ,,	0·91	8
July, ,,	3·58	17	December, ,,	3·89	15
August, ,,	1·44	7	January, 1930	5·10	16
September, ,,	1·67	11	February, ,,	0·96	5

Of the total September rainfall, 0·90 in. fell on the 26th and 27th, five and six days after the September application of nitrogenous fertilizers.

The writer wishes to acknowledge the co-operation of Mr. Carpenter, and his unfailing interest and help at all stages of sowing and harvesting the crop. The Department of Agriculture has conducted wheat experiments on this farm since 1923. Thanks are also due to the Wheat Research Institute for carrying out milling and baking tests, and to the Canterbury Agricultural College for supplying rainfall data. The assistance of fellow officers is also gratefully acknowledged.

Trimming Gorse Hedges with Tractor.—A tractor with gorse-knife attached was observed the other day doing excellent work trimming gorse fences on a farm at St. Andrews, South Canterbury. The owner of this 600-acre property, which is well subdivided with gorse fences, states that he saves £50 per year in labour by the tractor method.

DISSEMINATION OF CLUB-ROOT IN THE DUNG OF FARM STOCK.

J. G. GIBBS, Mycological Laboratory, Plant Research Station, Palmerston North.

FARMERS who grow rape, turnips, or swedes have found to their cost that the yields of these crops are often severely reduced by attacks of club-root. It may be again stated that this disease is caused by a microscopical organism, *Plasmodiophora brassicae*, which enters the roots and causes an abnormal proliferation of the root tissues. The resulting malformations or "clubs" by which the disease is usually recognized contain great numbers of spores, which, on the rotting of the diseased tissue, are capable of persisting in the soil for a period of about three years.* At any time during this period these spores may produce the disease on any susceptible root (rape, turnips, &c.) with which they may come in contact.

Frequently spore-laden soil from a known infected area is carried to non-infected ground on farm implements, feet of stock, boots of farm workers, or by surface drainage water. The disease is also often widely spread about a farm by the feeding-out of infected roots to stock. Knowing this many farmers have attempted to prevent the transference of the disease to their turnip paddocks, but frequently without success. To determine whether spores consumed by stock fed on diseased material are capable of causing infection when passed out in the dung the writer planned the experiments here recorded.

EXPERIMENTAL METHOD.

Seven sacks of club-root-infected swede roots were collected and supplemented with an equal quantity of healthy roots. These were mixed in approximately equal quantities in a root pulper. Sufficient was pulped each morning for the day's requirements. A heifer was fed twice daily for ten days, commencing on 7th July, with about 50 lb. of pulped swedes per day. In addition she received a quantity of hay and was permitted to graze at will. The swedes were obviously relished from the first feed, and the whole of the ration was consumed daily.

In order to collect the dung under sterile conditions the heifer was tethered in a barn the concrete floor and walls of which had previously been sterilized by a copious washing of 1–1000 acidulated corrosive sublimate. Her feet were free from adhering earth, and all dung was collected before being trampled. A portion of the dung was caught in a sterile shovel as it was passed, but most was collected from the floor on the bedding straw immediately it fell. The portions caught on the shovel and taken from the floor were kept apart and tested separately for the presence of the club-root organism.

On 18th July the heifer was returned to the paddock, and fed as before until 21st July, when a further sample of dung was obtained under sterile conditions with the aid of an enemeta.

Further samples of dung were obtained from the paddock in which the heifer grazed. A sterile shovel was used to remove the top portion

* See references 1 to 4 at end of article.

of some of the most recent, compact, untrampled dung-pats, leaving the lower ½ in. in contact with the soil undisturbed. Thus samples of dung were obtained which were considered to be free from chance contamination by the club-root organism.

In these experiments all containers, instruments, and hands were sterilized by flaming or with 1–1000 acidulated corrosive sublimate for ten minutes.

A ram was subjected to the same feeding conditions as the heifer, but owing to his dislike of swedes he had to be more closely confined. He commenced eating swedes on 13th July and fed exclusively on these and hay until 21st July, when he was placed in a sheep crate and brought to the barn. Here his feet were washed and the crate sprayed with 1–1000 corrosive sublimate. The posterior portions of the ram were thoroughly soaked with the same solution, and a sterile sack was then attached in such a manner that any dung passed was caught. The animal was then returned to the crate and fed on cut grass. Dung was collected at intervals until the morning of 23rd July.

Testing Dung for Presence of Club-root Organism.

On 23rd July some of the cow-dung collected from the paddock was mixed with a portion procured with the enemeta and crushed in water in a sterile mortar. Some dung collected from the ram was also mixed with water under sterile conditions. In this manner was secured a fluid suspension of the dung of each animal, which was then distributed by means of a sterile pipette about the roots of rape seedlings growing in sterile soil in 4 in. pots in a glasshouse. Each pot contained about five plants, and eleven pots were treated with the fluid from each animal's dung.

About a week later a further batch of ten pots was similarly inoculated with a suspension of fresh club-root spores to indicate whether conditions were favourable for club-root to develop. Twenty-two pots were left untreated as a control. The results of the experiment are shown in the following table, the control pots being shown as two groups of eleven each.

Pot No.	Plants treated with Extract of Cow-dung.		Plants treated with Extract of Sheep-dung.		Plants treated with Suspension of Club-root Spores.		Plants untreated as Control.			
	Total Plants.	Per-centage infected.	Total Plants.	Per-centage infected.	Total Plants.	Per-centage infected.	Total Plants.	Per-centage infected.	Total Plants.	Per-centage infected.
1	5	60	6	33	5	100	4	0	4	0
2	5	100	5	40	5	100	5	0	4	0
3	5	100	5	20	5	100	6	0	3	0
4	3	67	3	0	4	100	6	0	3	0
5	5	100	7	71	5	100	5	0	2	0
6	5	0	5	80	4	100	3	0	5	0
7	3	67	6	50	4	100	5	0	5	0
8	6	100	4	100	4	75	5	0	6	0
9	5	60	6	33	5	100	6	0	5	0
10	4	75	2	100	4	100	4	0	5	0
11	5	100	7	28	..	..	0	0	4	0

The results show that of fifty-one rape plants subjected to a suspension of dung from a heifer fed on club-root-infected swedes 76 per

FIG. 1. CLUB-ROOT OF RAPE CAUSED BY DUNG OF HEIFER FED ON INFECTED SWEDE ROOTS.

FIG. 2. CLUB-ROOT OF RAPE CAUSED BY DUNG OF RAM FED ON INFECTED SWEDE ROOTS. [*Photos by H. Drake.*

cent. became infected with the disease. Of fifty-six plants similarly treated with a suspension of dung from a ram which had been fed on club-root-infected swedes 48 per cent. developed club-root, while in twenty-two untreated pots, containing ninety-five plants grown under similar conditions, no club-root developed. This evidence demonstrates that the spores of the club-root organism present in the fresh dung of cattle or sheep are capable of infecting crucifers with which they are brought in contact.

The following additional experiment was conducted to determine whether infection could occur when infected dung was mixed with soil. Dung from the ram was placed in a layer 1¼ in. deep in boxes of sterilized soil.* The heifer's dung obtained by the enemeta, caught on the shovel, and collected from the barn-floor, was mixed separately into boxes of sterile soil, while three boxes of similar soil were left as a control. Rape seed treated for five minutes in water at 130° F. was then sown in these boxes.

The results of the test were as follow :—

(1) Sheep-dung placed in a layer about ¼ in. beneath seed (two boxes)—
Box 1 : 21 plants examined ; no club-root present.
Box 2 : 21 plants examined ; no club-root present.

(2) Cow-dung obtained with the aid of an enemeta mixed with the sterile soil (three boxes)—
Box 3 : 22 plants examined ; 5 plants infected with club-root.
Box 4 : 20 plants examined ; 2 plants infected with club-root.
Box 5 : 28 plants examined ; 2 plants infected with club-root.

(3) Cow-dung caught on sterile shovel in barn before coming in contact with floor, mixed with sterile soil (one box)—
Box 6 : 25 plants examined ; 1 plant infected with club-root.

(4) Cow-dung collected from sterilized floor in barn mixed intimately with the soil (two boxes)—
Box 7 : 19 plants examined ; no club-root present.
Box 8 : 22 plants examined ; 1 plant infected with club-root.

(5) Boxes of sterile soil not contaminated by manure (three boxes)—
Box 9 : 23 plants examined ; no club-root.
Box 10 : 24 plants examined ; no club-root.
Box 11 : 20 plants examined ; no club-root.

NOTE.—The low degree of infection is probably due to a change in the soil used in the glasshouse. Subsequent tests have shown that this soil inhibits club-root development unless a fairly heavy concentration of spores is present.

In these tests club-root occurred when cow-dung was mixed with the soil, but not in the boxes containing sheep-manure. In view of the unsuitable soil used it is noteworthy that club-root infection occurred, and this appears to indicate a considerable number of viable spores in the dung of the heifer. Though no infection developed in the boxes containing sheep-dung, the fact that viable spores were present in this was demonstrated in the first test, which was conducted on more suitable soil.

Fifteen weeks later a further test was made in which cow-dung was crushed in water under sterile conditions and the resulting fluids distributed over boxes of rape plants growing in sterile soil. At the same time some pots were similarly treated with a suspension of sheep-dung.

* Soil boxes were sterilized separately by live steam at 98° C., being held for twenty minutes.

In these tests club-root developed from cow-dung which had been moist during the storage period, but not from similar material which had become very dry during storage. No infection occurred in the pots treated with a suspension of sheep-dung. This dung became very dry during storage.

This shows that, after passing through an animal, club-root spores may live at least fifteen weeks in dung that does not become excessively dry. Insufficient tests were made to prove that the drying of the dung effectively killed all the spores present.

Conclusions.

These experiments show that when club-root spores are consumed by sheep or cattle they are passed out in the dung and are than capable of producing the disease on any susceptible root with which they may come in contact. In addition it is shown that the spores may exist in a dung pat for a period of at least fifteen weeks without losing their vitality. This reveals a means of dissemination of club-root not previously considered in New Zealand.

Farmers and others who desire to grow crops free from the disease must either prevent the infection of the soil in advance of sowing, or apply large quantities of lime. As lime at economic rates has not yet been proved efficacious everywhere in New Zealand, measures to prevent the infection of the soil are of primary importance. Besides avoiding the methods of dissemination mentioned in a previous article (this *Journal*, January, 1931) precautions must be taken to prevent infected dung being dropped in the proposed rape or turnip paddock. As the spores of the club-root organism are known to live in the soil for several years, these precautions should be observed for at least three years before sowing a susceptible crop.

Under normal conditions it takes about twenty-four hours for material eaten by sheep and cattle to be present in the dung. Driving, excitement, or a purgative may decrease this period, while if stock are held without feed or are constipated the period will become much longer. Under average conditions all the refuse should be expelled from the animal one week after it is eaten.* Consequently, if the disease is to be avoided, one of the necessary precautions consists of selecting the area three years in advance and avoiding turning sheep or cattle on to this area until a week has elapsed since their last feed of club-root-infected roots.

Summary.

Experiments have shown that spores of *Plasmodiophora brassicae* passed in the dung of cattle and sheep are capable of producing club-root infection on rape. The spores may remain viable in a dung pat for at least fifteen weeks after it is dropped.

Farmers are recommended to select the ground for cruciferous crops three years in advance of sowing, and during this period to avoid turning stock into these paddocks within one week of their last feed on club-root-infected material.

* For this information the writer is indebted to Mr. R. H. Meade, Veterinarian, Department of Agriculture, Palmerston North.

The writer's thanks are due to the Principal of Massey Agricultural College, who provided the stock and in other ways facilitated the execution of the experiment.

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SEA-SHELL FOR POULTRY.

FRESH OYSTER COMPARED WITH OLD COCKLE MATERIAL.

H. A. KITTO, Overseer, Wallaceville Poultry Station.

AN experiment extending over a period of six weeks was recently carried out at the Wallaceville Poultry Station for the purpose of ascertaining which of two kinds of shell—namely, old bleached cockle and fresh oyster shell—would be the more palatable to fowls, and also to determine the respective value of these materials for egg-shell formation. Three hundred hens, divided among three houses, were used for the test.

At the outset equal quantities of the two kinds of shell, according to both weight and measure, were placed in boxes 15 in. square and 4 in. high, the shell being available at all times for the birds to pick at. All other forms of grit were previously removed from the houses. The following table gives particulars :—

Table 1.

House No.	Quantity by Measure.	Kind of Shell.	Weight in Pounds.
1	Three parts of kerosene tin ..	Old cockle ..	40
1	,, ,, ..	Fresh oyster ..	25
2	,, ,, ..	Old cockle ..	40
3	,, ,, ..	Fresh oyster ..	25

It will be observed from Table 2 that the oyster-shell proved by far the more palatable to the birds, for in order to keep a constant supply of it before them the boxes containing this grit had to be refilled on two occasions during the course of the experiment; whereas with the cockle-shell the birds in Houses No. 1 and No. 3 failed to consume the 40 lb. provided in the first instance by 20 lb. and 2 lb. respectively. It will be observed that three parts of a kerosene tin of cockle-shell

weighed 15 lb. more than did an equal measure of oyster-shell, and the table shows the total weight of each kind of shell consumed in each of the three houses.

Table 2.

Kind of Shell.	House No. 1.	House No. 2.	House No. 3.
	lb.	lb.	lb.
Fresh oyster	75	..	75
Old cockle	20	38	..
Total	95	38	75

Throughout the experiment the eggs produced in Houses Nos. 2 and 3 were frequently examined for the purpose of ascertaining the quality of their shells, but at all times these appeared to be equally good in both houses as between the two different materials. Allowing the same price for both materials, the results of the experiment go to show that the cockle-shell would be the more economical to use for the formation of egg-shells. Against this, however, there is the question as to what other uses fowls put the elements contained in sea-shell. Such other uses may never be fully known, but it is a fact that male birds, growing stock of all ages, and even hens not in a laying condition eat sea-shell by instinct, that they prefer certain kinds of shell to others, and that they maintain better health with the former than without it. This is sufficient proof that the material chosen is eaten for purposes additional to the formation of egg-shells. No doubt one of the chief functions of shell is to supply lime for bodily requirements, and to assist the bird to digest its food. In regard to the latter it is safe to assume that cockle-shell, owing to its hard nature, is of greater service in grinding the food in the gizzard than ordinary oyster-shell.

In the feeding of fowls it is now generally recognized that if the best results are to be obtained palatable food is imperative. In other words, fowls preferably eat what they like, and what they like is usually what they need for the maintenance of good health and vigour. Assuming that this rule applies in a similar manner to sea-shell, as the use of fresh shell, even though a greater quantity is consumed than is the case with old or bleached shell, may prove the most economical in the long-run.

The influence, if any, of different classes of sea-shell on the production of eggs will be the subject of further experiments.

Broadcasting Seed on Grassland.—The Instructor in Agriculture, New Plymouth, remarks as follows on this subject: "The broadcasting of grass-seed with the object of strengthening weak swards is a matter that is more or less uncertain. Farmers appear to be afraid to disk with sufficient severity to open the sward up enough to let the seed into the ground so that it can be covered. One farmer in the Hillsborough district is very successful with surface sowing, and his method is to use an ordinary grain-drill with the coulters well tied down. By this means the seed is actually introduced into the soil and covered. The draught is great, but the results seem to be good. A disk coulter drill should do good work in this respect."

PRECAUTIONS NECESSARY IN HANDLING SODIUM CHLORATE.

As already referred to in the *Journal*, there have been several cases of burning recently following the use of sodium chlorate in solution as a spray for the destruction of weeds. These cases have happened where the person engaged had been wearing ordinary clothing and allowed it, after being saturated with the spray, to get dry and then come into contact with fire. A lighted match carelessly thrown down and coming in contact with the clothing, or the wearing of previously saturated clothes by persons standing in front of an open fire, has been responsible for most of these accidents.

If users of sodium chlorate as a spray solution will observe the undermentioned precautions there will be very little danger :—

(1) Sodium chlorate should be kept in the original drum containers as far as practicable.

(2) If removed from the original drum it should be packed in tins or other metal containers.

(3) It should not be packed in bags or other combustible containers. If it becomes necessary to do this *for a short time* the containers should be burnt immediately after emptying.

(4) Tins or other metal containers should be well washed when empty

(5) Sodium chlorate should not be allowed to come in contact with any combustible material ; consequently great care should be taken not to spill any chlorate on floors of wood or other combustible material.

(6) Persons using sodium chlorate as a spray should wear waterproofed clothes, such as oilskin or rubber leggings and jacket, or gum boots and jacket, which should be well rinsed in running water when the work for the day is finished.

(7) If ordinary clothing comes into contact with the spray the clothes must on no account be allowed to dry, but be removed at the earliest moment and then carefully washed. Ordinary clothing mixed with dry sodium chlorate, such as results from the drying of the spray on clothes, may become both explosive and highly inflammable, and be exploded or set on fire by heat, friction, or concussion.

(8) Sodium chlorate is liable to explode by percussion and friction in the same way as chlorate of potash. Hence, even when unmixed with combustible matters, sodium chlorate should be handled with care, and not dropped on to a concrete, tiled, or iron floor, or subjected to any violent blow.

Starters in Cheesemaking.—In the course of a report on recent work at the experimental factory of the Dairy Research Institute, at Palmerston North, the Director of the Institute makes the following reference to cheese starters : " Study of methods of keeping mother cultures of starter marks the beginning of an intensive study of starters as a whole. It is well known that starters ' go off ' suddenly, even though no essential difference has been made in their treatment. It is desired to obtain some information on the cause of this ; and in the beginning special attention is being paid to the effect of methods of keeping mother cultures. It will take some considerable time to collect reliable information on this point, as there is no laboratory test at the present time which is a reliable index of the manner in which starter will act in the cheese-vat ; and results can be obtained only by making a considerable number of cheeses from starters treated in different ways. In conjunction with this work on starters, chemical studies are being undertaken on the changes that take place in the process, with a view to collecting exact information upon these changes, so that it may be used to advantage in the cheesemaking process under New Zealand conditions."

SEASONAL NOTES.

THE FARM.

Value of Grazing Management.

MANY farmers do not give much thought to possible means of improving their grazing management. They are somewhat apathetic merely because they have not yet realized to what extent production can be increased and cheapened by better grazing. They have not become aware of the truth that skilful grazing is often just as important for improving grassland and keeping it improved as is correct manuring.

Especially at the present time of low prices for farm produce should the potentialities of improved grazing management make a successful appeal. This is because improvement in grazing is often a matter more of the use of the latest ideas than the use of money. Seldom can improved grazing be introduced successfully without careful preparation and planning—preparation and planning which may well be based on study of results obtained during the current season, while these results are still fresh in our memories. For instance, with a view to better control of pasture-growth during next season, we might well ask ourselves at this stage whether it would have appreciably eased the task of grazing management this season had certain fields been subdivided, or would it have helped had our ensilage programme been different. If changes in such matters are desirable, then it is well to have considered them in good time so as to be ready to proceed with them when the relatively slack season of the year arrives.

A point of great importance is that grazing management is at times the link that governs the results of other practices which are efficient in themselves, but which do not stand or fall as economic propositions solely on their own merits. Top-dressing illustrates this point very well. It may be said safely that some of the disappointing results obtained are due not to incorrect practice, but to the fact that full use has not been made of the improved growth brought about by the top-dressing. Understocking of top-dressed areas may lead to the appearance of coarse woody herbage which is unsuited to the needs of the grazing stock, to checking of the clover which is so valuable a portion of the herbage, and to undesirable opening-up of the sward. Hence top-dressing, which is efficient as a means of improving pasture production, may conceivably prove undesirable under unfavourable grazing management. All of which serves to emphasize the important role of grazing management, which in a general way probably offers more scope for improvement than any other aspect of grassland farming. The need is to initiate preparations now for the improvements of next season.

An Economic Aspect of Top-dressing.

There is some evidence which seems to indicate that there will be a regrettable falling-off in the consumption of fertilizers for top-dressing of grass. In some instances this will be on the part of those who could finance the purchase of fertilizers if they wished to do so, but who apparently are not definitely convinced of the profit-earning nature of the use of manures on their grassland.

To some of these it may not be absolutely clear that a comparatively small increase in production may have a relatively large bearing on the profit or loss returned from a farm. For instance, a 10-per-cent. increase in production due to the use of fertilizer on grassland may represent much more than a 10-per-cent. increase in profits. Indeed it may represent the difference between a loss and a profit. The main or material items that

require to be set against the returns from the increased production are the cost of the manure and the interest and depreciation on the extra stock utilized. The overhead charges for land, equipment, and labour would be substantially the same for the lower as for the higher production. Hence, properly, such charges may often be omitted from consideration when estimating the returns from top-dressing.

To take a concrete case, if the carrying-capacity of a farm is increased from forty to forty-four cows by top-dressing, then the top-dressing may rightly be credited with the whole of the returns from the extra stock, less only the cost of the fertilizer and the cost of interest and depreciation of the stock. If top-dressing were considered carefully in this way as often as it should be, then some who are proposing to dispense with its aid during the coming season would assuredly find reasons for changing their minds. In view of the fact that in many districts autumn top-dressing is productive of markedly good results, this is a matter that calls for attention without further delay. It is well to remember that it will be the exception rather than the rule for reduction of expenditure on top-dressing to prove true economy.

It may be instructive to recall that when there was a serious slump in prices some years ago there was an immediately corresponding fall in fertilizer sales. The significant feature connected with this was in what happened later—fertilizer sales soared to a higher point than ever previously when it was realized that top-dressing was a considerable aid in facing a period of low prices.

In general the value of phosphatic manures has been established definitely. Of these superphosphate is most largely used. The popular preference for super seems to be justified by field observations; it will give superior results under low rainfall conditions, and where the rainfall is high it will generally at least hold its own with other phosphatic manures. Of the phosphatic manures it most quickly makes its influence felt in the form of increased growth, it usually continues to exert considerable stimulating effect on growth for twelve months or more after its application, and, practically, the sourness of the soil is unaffected by it.

But on certain farms splendid results have been obtained from the use of basic slag. In such cases the use of slag should not as a rule be departed from except in a trial way, until the superiority of that which is to be substituted has been established. When the immediate influence of the top-dressing is not a matter of moment, then African and similar phosphates are at times worthy of consideration in districts of good rainfall. Under a wide range of conditions a mixture of equal weights of one of these phosphates and of 44-per-cent. superphosphate can reasonably be expected to give good results in pastures.

In the case of young pastures the fertility of the land being grassed has a considerable influence on the nature of the herbage which establishes itself during the first few months. Hence, top-dressing is at times advisable for enabling desired species to successfully establish themselves rather than to disappear, leaving an unduly open and inferior sward.

On many pastures mature woody growth has been left over from the summer. As a rule such mature growth should be removed in the autumn; its presence is unfavourable to the ready development of the fresh leafy "bite" which at this season characterizes fields which have been well grazed throughout the year. If it is not practicable to employ store stock for the removal of the tall mature growth, then it becomes advisable to effect its removal by topping with the mower.

Harrowing of pastures is rightly receiving more attention now than at any earlier period. Harrowing may be expected to prove particularly valuable for the purpose of loosening up a matted compact sward, which

is at times the result of many years' gradual deterioration. Drastic treatment of such a sward is usually well justified. Harrowing is also at times specially desirable on fields on which droppings have been allowed to accumulate undisturbed during the summer and autumn.

The Wheat Crop.

Success with wheat demands a well-drained soil which favours the natural deep-rooting habit of the crop. Hence, if portions of paddocks which are to be sown in wheat, especially winter wheat, are inclined to be badly drained during the wet season, then any practical means of draining such portions should be employed. Otherwise, if wheat is sown on such undrained land it will most likely perish if an extended wet period is experienced. Success may be expected when wheat follows peas, tares, or red clover, all of which leave the ground in a fertile friable condition. Good crops of wheat also frequently follow rape, after which the land is easily worked, available at the proper time, and in good heart. Growing wheat on land just ploughed out of pasture is frequently practised with good results, provided preparatory cultivation is commenced in good time and is carried out thoroughly. Wheat after potatoes is also usually successful.

Wheat fares best in a fine firm seed-bed. Because firmness is advisable it becomes possible often to dispense with ploughing after potatoes or peas, thorough disking being sufficient. The need for fineness in the seed-bed is fulfilled, provided a good mould is produced in the lower cultivated layer. For autumn sowing of cereals, clods on the surface layer are desirable rather than undesirable; they tend to provide winter shelter for the seedlings, and to check the setting of the soil into a hard surface layer as they gradually weather down into loose granular material.

When wheat is to follow pasture skim-ploughing should be done early in the autumn, and if it has not been done at the time of publication of these notes it should be proceeded with as quickly as possible. After the skimmed furrows have been exposed to weathering for some six or eight weeks they should be disked, and the land then ploughed to the full depth. By this method finely pulverized matter is placed at the bottom of the full furrow, and lumps are brought near the surface where they can be pulverized by suitable cultivation. Early cultivation of grassland means that there is time for the buried sward to decay properly and to enrich the remainder of the soil. When wheat follows another cereal the stubble should be disked or grubbed and the land later ploughed to full depth.

In the main wheat-growing areas of the South Island autumn or early winter sowing should be followed wherever possible. In the most southerly wheat areas and in the North Island spring sowing is usually most suitable. The standard varieties, Hunters, Pearl, and Velvet, require autumn or early winter sowing; solid-straw Tuscan may be sown in the spring as well as in the autumn and early winter. In the North Island Jumbuck, Major, and John Brown are favoured for spring sowing.

Oats and Barley.

Oats to be used for the production of winter and early spring feed, and subsequently to be allowed to develop for grain production, should be sown in April or in early May. The proved kinds of Gartons are the best all-round oat for the South Island. Algerians are deservedly popular for the production of green feed in autumn or spring and for the provision of good chaff. Gartons, which will not stand grazing to the same extent as Algerians, should be fed off once only and that quickly. When barley and Algerian oats are grown primarily for green

feed a number of successive grazings when the growth is relatively low usually proves preferable to a single feeding-off of tall growth. The successive grazings of short growth avoid undue waste by trampling and result in the consumption of better balanced and more attractive herbage.

Manuring of Cereals.

During recent years there has been a substantial increase in the amount of manure used in the growing of cereals—an increase well justified on the evidence provided by observed results. Last season much the greater portion of the South Island wheat crop received the benefit of about 1 cwt. per acre of manure, most of which was phosphatic. This practice conforms with the results of field trials, which show that over wide areas the use of about 1 cwt. an acre of superphosphate with wheat gives definitely profitable returns. As a general rule autumn-sown oats and barley will also respond profitably to an application of from 1 to 2 cwt. per acre of manure of which superphosphate is a principal constituent.

Seed Treatment of Cereals.

Widespread diseases of the three crops wheat, oats, and barley may be controlled by suitable treatment of the seed prior to sowing. These diseases are certain of the smuts, which are annually the causes of considerable financial loss. Covered or stinking smut of wheat may be taken as an example: This fungoid parasite, as a dark brownish mass, fills the skin which in ordinary circumstances would hold the healthy grain. The disease is spread through minute portions of the parasite being deposited on the outside of the grains of wheat. Hence, seed from a healthy crop may readily become contaminated with the disease by contact with sacks or machinery which have held diseased crops. Therefore, to be on the safe side, even when using seed from a healthy crop, it is usually worth while to suitably treat the seed against smut.

The best method of treating the seed against stinking smut is the dry-dusting of the seed with fine copper carbonate powder, but farmers who have not the proper equipment for doing this will have to adopt another form of treatment, or utilize the services of merchants who are suitably equipped to carry out the copper carbonate treatment of seed in bulk. The points in favour of copper carbonate treatment are (1) that it involves no danger of injury to the seed, (2) it calls for no handling of wet seed, and (3) treated seed can be held without deterioration, therefore it can be done at a convenient time prior to the busy seed-sowing period.

When the copper carbonate treatment cannot be adopted, pickling with formalin can be accepted as the best available substitute; methods are described in the March, 1930, Farm Notes in this *Journal*. In view of the fact that at times relatively ineffective methods of treating cereal seeds are practised, growers should make themselves acquainted with the proper methods of doing the work.

Though treatment of seed oats and barley for smut is not carried out so generally as treatment of seed wheat it can be made just as effective, and there is just as much need for it in the case of any crop that possibly will be harvested for chaff or grain. The barleys are much neglected, but there is possibly even greater neglect of the Algerian oat, which some consider free from attacks of smut, but which is just as subject to it as other varieties of oats.

Miscellaneous.

If early frosts have not already injured such crops as maize and millet, these should be dealt with with the minimum of delay along the lines described in last month's notes.

Often weeds invading lucerne may be dealt with effectively by suitable cultivation in April. Disk harrows are not suitable for this work; they have a cutting action which leads eventually to undesirable thinning out of the crop. Any cultivator used should be fitted with specially fine tines in order to minimize the damage to the lucerne plants. Often, especially when the soil is of open texture, it is good practice to follow the cultivation by the sowing of a bushel of Algerian oats per acre. When this has been done, plans should be made to harvest the resultant growth early in the following spring as silage.

At the present time cultivation will be the chief concern of many experienced farmers; there is not only the cultivation for the various cereals, but also often the initial cultivation for such crops as lucerne and mangels which may with advantage be given attention.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Late Spraying.

DURING this period of the year operations in the orchard are mostly confined to harvesting and packing the crop of pip-fruits for overseas and local markets. In addition, however, occasion may arise when the application of late sprays becomes necessary to control pests and diseases which persists until late in the season.

A close watch should be kept on late varieties of apples and pears in order to guard against that form of black-spot which is so often associated with dewy nights and the increasing humidity following early autumn rains. Immediately infection is observed it is wise to revert to an application of lime-sulphur at a strength of 1–100, otherwise a large percentage of the fruit may have to be rejected for only slight infection, which can be avoided. In addition, a late application of arsenate of lead is generally a good investment to prevent damage by leaf-roller caterpillar to the late varieties of apples, particularly those with short stems, such as Sturmer, Rokewood, and others.

Emulsifying Oils.

Mention of certain features which have come under the notice of the writer during the past month may be of service to readers. Many instances of incomplete or imperfect emulsion of emulsified winter oils for application during the active season have occurred. In one instance stale oil which had been contained in a cask for a long period proved quite unsuitable for applying at this season of the year.

In other instances the same type and brand of oil freshly obtained in tins gave perfect emulsions by adopting the following methods in mixing: To each gallon of oil slowly add 4 gallons of water in which $\frac{1}{4}$ lb. of soap-powder has been dissolved; the water should be slowly added to the oil while a vigorous agitation of the combining liquids is maintained. The primary emulsion thus obtained should be then poured from one vessel into the other four or five times, giving the liquid a fall of 3 ft. to 4 ft. from one container into the other. The primary emulsion can then be poured into the spray vat and the engine started; next slowly commence to add water until the propellers of the agitators are covered, after which the main quantity of the water can be added quickly without any anxiety regarding reversion to free oil. The importance of obtaining perfect emulsions should not be underestimated, otherwise spotting of the fruit is likely to ensue.

The standard winter oils have proved very efficacious at a strength of 1–150 for control of red mite in the active season, and they also seem to refresh the foliage of the trees in the hot dry weather. Possibly this effect can be accounted for by a reduction in the rapid transpiration of the foliage during such periods.

Manuring.

Manures which are slow in action such as basic slag are best applied in the early autumn. Applications of lime should also be made at this time of the year.

—M. Davey, Orchard Instructor, Mapua, Nelson.

Citrus-culture.

This period of the year, while the crop is developing, is a good time to overhaul the trees. All exhausted wood and water shoots should be removed, and the lower branches trimmed in order to keep them clear of the soil. If this is not done there is more danger of brown-rot infection during the period of autumn rains. These rains, falling on warm ground, are likely to perpetuate the spores of the disease if the soil does not have a chance of drying out fairly rapidly. As a preventive measure the trees should be sprayed with bordeaux, 4–4–40, and repeated applications made if necessary.

In all cultural operations care must be exercised to prevent the soil becoming unduly high round the trunks of the trees, as this is often a cause for collar-rot. Care must also be taken not to leave depressions near the tree where water can lodge.

The present is a good time to attend to the sowing of green cover-crops which can be turned under later on. The application of the autumn manures, as recommended in last month's notes, should be made to coincide with the sowing of these crops, and will greatly assist the growth as well as benefiting the trees. Blue lupins, tares, and Lotus angustisimus all make good material for building up the soil.

Intending planters will do well to remember that now is a good time to place orders for trees. If this is left until later the best of the stocks may be sold out, and it may be difficult to obtain what is required. Only the best should be ordered.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Management of the Pullets.

THE pullets must now be given the very best of management, so that they shall not fail in their future function of winter egg-production. In the first place care must be taken that the birds are not subjected to any sudden change in the system of management. The changing of the food or quarters, even if it be ever so slight, when the pullet is on the point of laying or just started to lay, will invariably bring on at least a partial moult, whereby the bird's energy will be diverted to the production of new feathers rather than the laying of high-priced winter eggs. It may be added that the early-hatched birds, particularly the more precocious pullets which have commenced to lay, say, in January, will probably not continue to lay during the winter season, for the reason that they will go into a moult at the same time or perhaps a little later than the adult flocks.

The pullets that should give the most profit are those which have been specially hatched out to lay in winter—say, at the end of September for

the light breeds and a month earlier for the heavier—and which are well grown and start to lay in April. Providing these birds are properly handled they will go right through their first laying-season without moulting. Even these, however, are apt to go into a semi-moult if the treatment they receive is not uniform in every respect.

It is important that the birds be treated in a kindly manner. An endeavour should always be made to make the birds tame by going gently among them and talking to them, so that they may have confidence in their attendant instead of doing their best to get out of his way.

Housing.

It goes without saying that the pullets cannot be expected to lay to the best advantage during the coldest season of the year, when all things in nature are against their doing so, unless they are well protected from extreme conditions and are given every opportunity to take ample exercise in comfortable clean quarters. Hence the houses should be spacious, not having merely enough room for the birds to roost in by night, but sufficiently large to accommodate them well and provide healthy exercise at all times. The value of indoor exercise for laying birds is not as generally realized by poultry-keepers as it should be. The best way of inducing exercise is to bed the floor of the house with strawy litter, in which the grain foods should be scattered. It is important that the birds be fed under shelter at all times, and not be compelled to wait about in the yard for feeding-time on cold, wet days. Only the pullet provided with dry footing, both by day and night, can possibly give her maximum egg-yield during the winter.

Speaking of litter, it will usually be found an unwise course to have the floor of the house thickly covered with this when the pullets are first placed in their winter quarters. When pullets are entering their productive season, and are placed in a house with a heavily littered floor to which they have not been accustomed, they are not only apt to become upset, but they may also fail to find the full grain ration provided, and this at the expense of the egg-yield. The best plan is to have the floor lightly littered at the outset and to increase its depth as the season advances. In this way the birds will be better encouraged to acquire the habit of scratching for their food, while, in addition, the litter itself can be maintained in a more sanitary and better condition for the birds to scratch in. Reasonably thick litter—say, from 6 in. to 8 in. deep—serves a desirable twofold purpose, by providing exercise for the birds and by keeping the quarters in a much warmer condition than would be the case without it.

One cannot over-emphasize the necessity of having no cracks in the back or side walls of the house. The slightest crack is apt to let in a cold draught, the most common cause of colds, which are forerunners of croup.

Feeding Points.

Perhaps the most important principle in the management of laying pullets at this or indeed at any time of the year is to feed them well from first to last. The bird must necessarily manufacture her eggs out of the food she consumes, and it is obvious that if she does not get a generous supply her egg-yield will decline as a consequence. The feeding should be regular, and no unnecessary variation in the food should be permitted. The food should also be made as appetizing as possible.

The morning mash, which may be made up of two parts of good-quality pollard to one part of bran by measure, should be moistened with meat soup or skim milk, and if these liquids are not available boiling water is the next best thing. Where good-quality pollard is not available a mixture of one part of finely ground good-quality wheat to two parts of bran will usually give better results than can be obtained with inferior pollard. For

the evening meal wheat, when the price warrants its use, is the staple grain, but it is a good plan to mix oats, maize, or even hulled barley (which is now on the market) with it.

The manner in which the birds relish the different kinds of grains should be taken as a guide as to the quantity of each that should be included in the mixture. If the birds show a dislike to any particular grain this should be given in reduced quantity. Of course, allowance must be made for the fact that fowls will often take some time to become accustomed to a new kind of food. When providing the evening meal it is a good plan to give more food than the birds will eat, so that they may be kept busy scratching for any left-over grains after leaving the perches in the early morning.

Animal Food in the Diet.

Animal food in some form is a most important item in the dietary of the winter-laying bird. It should, however, be used with the greatest of care, for if meat or meat-meal, &c., are fed to excess in a mash mixture serious trouble may result in the form of ovarian disorders such as protrusion of the oviduct. Obviously all birds do not need the same amount of animal food. Some may not want any, others may be content with a mere taste of it, while there may be birds—the heaviest type of layers—which will demand a heavy supply of the nitrogenous material. The amount of forcing food required by a bird is largely governed by its laying condition and its capacity to lay. Hence—especially where large flocks are concerned, in which there must naturally be a wide variation in laying-capacity between the individual birds—any forcing food should be chiefly fed separately, so that each bird may obtain all it requires and no more. The real danger lies in compelling a bird to eat more of a forcing food than is good for her in order to secure a meal. Even where the mash mixture is moistened with meat soup or skim milk, or where the latter is given in large quantities to drink, meat, meat-meal, &c., should be sparingly included.

If fowls are to do their best in winter they must also be provided with plenty of green material, while gravel-grit and crushed sea-shell should be within their reach at all times.

Uniformity of Method.

The importance of uniformity in all matters pertaining to the winter layers, if they are to be prevented from moulting, will thus be realized. It may be repeated that the chief causes of moulting are insufficient food, inferior food, too many changes in the system of feeding, changing the quarters, and also allowing the birds to contract colds.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Preparations for Winter.

As the honey-flow is now definitely over for the season, and extracting finished, the next work will be the preparation of the bees for winter. It is assumed that in most cases sufficient stores have been left in the hives. From 30 lb. to 40 lb. will be required to tide a colony over the winter and early spring.

If sealed combs of honey from clean colonies are not available, colonies that are short of stores should be fed as soon as possible with syrup composed of equal parts of sugar and water. It is better to feed heavily now, where necessary, than to wait until the bees have used up their meagre stores. The bees cannot leave their cluster during the cold months of winter and early spring to take down any syrup that may be offered them, or generate sufficient heat to evaporate any surplus moisture it may contain. It is not

recommended to feed sugar syrup, but it is necessary in the absence of sealed honey stores as there is a risk of introducing disease by the feeding of honey unless it is definitely known that the apiary from which it is obtained is quite free from foul-brood and has been so for some years.

It is generally admitted that honey-fed bees have a better constitution than those fed with sugar, and will build up better in the spring. There is also reason to believe that some sorts of honey are better than others, but of this we have no definite proof. There is a marked difference in the specific gravity of our honeys.

The entrance of all colonies should now be reduced. The average colony will require an entrance 3 in. to 4 in. wide. If the height is more than $\frac{5}{16}$ in. this should also be reduced, in order to prevent mice getting into the hive.

When stacking away the supers of combs for the winter place a sheet of newspaper between each super, and a roof or its equivalent on top, to keep out mice and wax-moths. Pack away any foundation that may be left over in a light and air-proof box. It will become very brittle if left exposed to the atmosphere.

Keep a sharp lookout for foul-brood, and, if discovered, deal with it at once by one of the methods recommended, or destroy the colony. It does not pay to risk it spreading by robbing during the winter.

If robbing sets in, place a strip of wood in which an escape has been fitted across the entrance of the colony that is being robbed, and leave it until after sunset. Then reduce the entrance to not more than 1 in. in width.

Weak and Queenless Colonies.

As advised last month, queenless colonies should be disposed of by uniting them with strong queen-right colonies. This is most readily accomplished in the evening when all field-bees have returned. After taking the roof and mat from the queen-right colony, place a sheet of newspaper immediately over the top of the frames and carefully place the queenless colony on top. No smoke will be required if the hive is handled gently. Weak colonies should be similarly united if the queen is of little value. If the queen is young, brood-rearing will probably be kept up for some time, and such colonies, though weak, will probably be worth saving. This is best accomplished by shifting them into a small hive, called a nucleus box, large enough to take only four frames.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Small Fruits.

WHERE currants—black, red, or white—gooseberries, raspberries, or loganberries are to be planted, there should be no delay in locating suitable plants. They should be selected while growing and at leisure, so that there may be no mistakes. Receipt should be taken of them as soon as they are ready to lift, and they should be heeled in carefully if the grower is not ready to plant immediately or if wet weather interrupts the work. The plants are quite safe heeled in, and to work the land when sticky is to do damage that is generally serious for a long time.

These crops are specially suitable for the cooler localities, in the southern latitudes or higher altitudes. Such places have actually an advantage in growing these crops. They all do best on good land, moist, but well-drained and also sheltered. The gooseberry and red and white currants are inclined to be something of an exception; they thrive well on lighter land and in a rather more open situation.

Commercial plantings are usually 6 ft. between the plants both ways—that is, 1,210 per acre. Exceptions are raspberries, which are better

planted 1 ft. apart; black currants, 3 ft. apart; and loganberries, 8 ft. apart. These distances are between plants in the rows, the rows themselves being 6 ft. apart as stated. There need be no ceremony about planting; only plant firmly at the right depth. The plants are best pruned later, shortly before they start into growth.

Cut away runners that may be formed on the strawberry crop, and give shallow cultivation in fine weather to suppress weed-growth.

Nut-culture.

This crop is strangely neglected by growers here. Large supplies of good nuts are obtained from overseas, at reasonable prices it is true; but why send thousands of pounds away annually for a primary product we can grow well? No doubt there is room for some extension in planting if it is carefully done.

Walnuts require good alluvial land to do their best. As a group for shade purposes or an avenue, or rowed out like orchard trees, they do well. The former methods are perhaps most appropriate for the present, as generally only seedling trees are available. When grafted trees of suitable varieties are available in a district, more extended planting will be warranted.

Sweet chestnuts are an excellent vegetable; they are usually produced abundantly on good hill country. The remarks otherwise made regarding walnuts apply to these also.

Sweet almonds for dessert or cooking are popular. Worked trees in different varieties are procurable. In Hawke's Bay they crop well, and would doubtless do so in many other localities. They much resemble the peach-tree, but require less attention. It is necessary to plant different varieties together, so as to pollinate the blossoms and make them fruitful.

Filberts (Barcelona nuts), otherwise known as hazel or cob nuts, also merit attention. Small groves that are cropping well in different places in the Dominion supply evidence of the possibility of successful planting. Distinct varieties are available, but they should be chosen with a view to arranging suitable pollination. The many failures of the past are due to allowing the trees to sucker, and to planting unprofitable seedlings. The trees do well on the poorer class of soils, and are best planted rather close —say, 10 ft. apart in the rows.

Where nut-crops are ripening a cloth should be spread and the limbs shaken to make the nuts fall. By lifting the cloth the nuts are thrown on to trays, which are stacked in a dry place to thoroughly dry out. This is most important if rancid nuts are to be avoided. Direct sunlight, if it is very hot, is apt to open walnuts that are not well sealed, by drying them too quickly. To dry them evenly they should be turned occasionally by stirring them with the hands. As soon as the nuts are dry put them over riddles to eliminate waste and undersized ones. When thoroughly cleaned bag them up and store in a dry, clean, airy place where they are secure from the attack of vermin.

The Outside Tomato-crop.

Growers twenty years in the tomato-growing business say they have never had such a late season. This may not apply to all localities, but is evidently very general. It probably means that there will be considerable areas of late-planted outside crop commencing to ripen just as the winter frosts commence. If the market warrants it, and the situation of the crop is favourable, it may be worth while doing a little frost-fighting to protect it for a week or two. Those who are interested in this problem should refer to Vol. 36, page 382, and Vol. 37, pages 19 and 106, of this *Journal*, where a full description is given of a demonstration carried out in Central Otago by Mr. W. R. L. Williams, Orchard Instructor. The crop dealt with in this case was stone-fruit, but the principles enunciated and apparatus used

are applicable to saving the tomato crop. In Vol. 39, page 158, Mr. Williams also gives an account of the protection against frost of a large tomato-crop at Earnscleugh. Before taking up these measures, however, growers should first make sure it is going to pay to do so.

A new experience with the outside tomato crop this season has been the severe attack of a stem-boring caterpillar identified by the Plant Research Station Entomologist as *Phthorimaea melanoplintha*, a species of the potato moth, *Phthorimaea operculella*. In habit and general appearance they seem identical. Splendid crops, full grown and well set with fruit, have suddenly commenced to wilt on the trellis, and examination has shown the base of the stem to be riddled by the borer, commencing to decay, and the functions of the plant entirely destroyed. Other plants less seriously attacked may be able to finish ripening the fruit, but the proportion of losses has in many cases been very high. An epidemic of this kind, in such a season as has been experienced, is very surprising. This pest provides another reason for adding arsenate of lead to the bordeaux spray generally used. It should be carefully mixed, as usually advised, as the quality of adhesion is then at its best. To protect the plant from this pest it is necessary to carefully cover the main stem, just above the ground, as that vital spot is attacked in every instance, and usually that alone. A further important contribution to the control of the pest will be to burn or destroy all parts of potato, tobacco, and tomato plants—in fact, any plants of that family, as soon as the crop is gathered. If the temperature is suitable this moth matures very quickly, and there are many generations in the one season. The Plant Research Station is giving the subject close attention, and it is quite possible that further information may be obtained on controlling this pest which has suddenly gained such notoriety.

The Market Garden.

About this period—earlier or later according to locality—it is customary to plant out early cabbages and cauliflowers that will mature during the month of September—valuable crops that deserve every consideration. With all crops of this class strain of seed is of first importance. Next to that comes careful selection from the seed-beds. When lifting plants select those of a good size and even, with strong heart-buds. If plants are bought, carefully inspect them for club-root disease and discard cull plants.

Other areas now are probably in winter crops of savoy, cauliflower, broccoli, leeks, and celery, also root crops of parsnips, beet, and late-sown carrots. Areas which have carried half-hardy crops, however, will soon be vacant, and present an opportunity for sowing down in green cover-crops. This chance should not be missed. In the absence of stable manure, which is too scarce for general purposes, growing green cover-crops is the only way of maintaining the supply of humus in the soil. Humus has important chemical and mechanical effects that are indispensable, and which cannot be obtained from chemical fertilizers. Soil temperatures and moisture, as well as bacterial activity, are greatly improved where a sufficient supply of humus is maintained. By pulverization and oxidation during the ordinary operations of continuous cropping large quantities of humus are used up. The need varies in different classes of soil, but many new lands, and also those of a heavy nature, generally require a good deal. As soon as the previous crop is removed now, light cultivation is usually all that is necessary before sowing the area down in barley, oats, and vetches, or horse-beans. These crops are hardy, and will make rapid growth at a season when scarlet and other clovers would make little progress. Early sowing now will assure a large bulk of vegetation for turning under in good time for it to sufficiently decay before starting early spring crops.

Before mowing off the ripe foliage of an asparagus crop it is often profitable to harvest the seed if the plants are of good strain. Gather the seed only from mother plants of good type. Seed-beds of cabbage, cauli-

flower, and lettuce are sown down about this time, with a view to providing plants for setting out in July. A sheltered situation is desirable, and even a frame may be necessary, especially for the lettuce plants, which are susceptible to rust disease if the weather should be wet as well as cold. Spinach for spring cutting may be sown now with good prospects of a profitable crop.

The Homestead Garden.

When making an investment, service, maintenance, and depreciation have all to be considered. The last-mentioned factor is one that is often unsatisfactory, but in planting trees and shrubs about the homestead—if the scheme is well worked out beforehand and afterwards protected until it is established—we have an investment that appreciates very rapidly instead of depreciating. It renders a good service in providing shelter, shade, and improved appearance, and maintenance can be kept down to a very low figure. There are two mistakes sometimes made by those who are drawing up such a scheme, one is to make the plantations monotonous, the other is to concentrate almost entirely on bright, showy plants that require considerable attention annually or even more frequently.

Between these two extremes there lies, as always, a happy medium. The beauty of flowering-plants lies very much in their environment, and the planting of a suitable setting is perhaps the most important feature in a good planting programme. The satisfactory background or setting is largely composed of evergreens of different shades of colour, of different shapes, height, and texture. These actually create an atmosphere that is quiet and temperate, in which the more showy plants not only look best but thrive best. For this purpose nothing is more appropriate than our native evergreens—a class of plants in which this country excels. There are many of moderate height that suit the bungalow style of architecture, which is so suitable and popular, in that they shelter and shade it without excess. Of these evergreens one of the handsomest is the karaka (*Corynocarpus laevigata*). As a tall shelter-hedge, in a mixed plantation, or specimen tree on the lawn, it is, when well grown, an evergreen as fine as any. The same may be said of the pohutukawa (*Metrosideros tomentosa*). A different shade of colour, with bright blossoms for a while, it will stand trimming and withstands winds. For the purpose in view no praise is too great for this handsome shrub that under natural conditions grows to a height of 15 ft. to 20 ft.

Two other families demand special consideration, as they contain several species that offer good resistance to the winds and are very attractive and useful as a setting for more showy plants; they are the Olearias and Pittosporums. Tarata (*Pittosporum eugenioides*), kohuhu—often miscalled matipo (*P. tenuifolium*), and karo (*P. crassifolium*) are the best known. The first is very fragrant, the second has the familiar wavy leaves and black stems, and the last has thick grey-green leaves and large fruit with tomentous, downy covering. Of the Olearias, golden akeake (*O. Forsteri*) is one of the most popular. Silver akeake (*O. Traversii*) is equally at home in a sea breeze. All these shrubs grow naturally to a height of 15 ft. to 20 ft. without trimming and form dense shelter. Of dwarfer growth are the Senecios and Veronicas that love the windiest places, and are even sometimes rather short-lived in more secluded spots. With taupata (*Coprosma Baueri*) we have effective native shelter-plants for most positions.

On the bank of a stream or in a more sheltered position tawa (*Beilschmiedia tawa*) planted in a group grows to a height of about 30 ft., and bears attractive fruit. Its character is of a most pleasing grace. Kowhai (*Sophora tetraptera*) is another light and graceful tree of moderate height, most suitable for the close vicinity of the home. Five-finger (*Nothopanax arboreum*) so well known is a useful "filler" with foliage of some character. Horoeka (lancewood) (*Pseudo-panax crassifolium*) with its long bare stem lifting the round head of foliage above the surrounding plants, is very

striking. In the middle districts kohekohe—sometimes called cedar, a most misleading name—(botanically *Dysoxylum spectabile*) is a round-headed tree of moderate height, with divided leaves that reminds one rather of the walnut. It is an excellent specimen tree, as also is the titoki (*Alectryon excelsum*). In northern districts where the puriri (*Vitex lucens*) is quite at home it forms a good specimen isolated on the lawn, and elsewhere a useful member in a mixed plantation.

Such evergreens as these that are not rare but noble, and native to the conditions about most situations, are quite the best for moderate-sized shelter close about the homestead, and for a setting about plants which are rare, and delicate exotics. When shelter and shade is thus established tree-ferns and nikau palms may be added with good effect.

—*W. C. Hyde, Horticulturist, Wellington.*

Maturing Cured Tobacco-leaf.

The question is often asked, How does New-Zealand-grown leaf compare with that produced in America, and why is so much American raw leaf being imported into New Zealand? The answer is that it is almost impossible to make a comparison, because the samples available are so entirely different, being separated by at least three years' expert storage. Actually there are leaves produced in New Zealand that are equal to the imported American in colour, texture, elasticity, combustion, and ash, but they are generally deficient in aroma, or the sweet-burning scent of the fully matured tobacco, which is only developed during long storage under proper conditions, and thus are inferior to the ready-to-use leaf imported from America.

The newly cured crop of tobacco-leaf contains a large amount of albumen; this, under proper treatment, changes into starch, and later the starch is converted into sugar. During this process of slow fermentation several other valuable oils and gums are generated. This fermentation only takes place satisfactorily under certain conditions, which may be briefly stated as follows: (1) The right amount of atmospheric moisture contained in the leaf when packed in bales or cases, 12 per cent. being correct. (2) The leaves must be packed so tightly together that no air can circulate, and the gases given off under fermentation are retained in the mass. Thus a package of 4 ft. by 2 ft. by 2 ft. should weigh about 500 lb.; this ensures the desired contact of leaves and absence of air. (3) The warehouse, barn, &c., in which these bales or cases of tobacco are stored for maturity should be maintained at temperatures not lower than 60° F. or above 75°.

If these three conditions are observed, and the quantity stored is about 10 tons, moved occasionally, top side down, the fermentation will take care of itself, and take from two to three years—two years for the finer-textured yellow-coloured grades, and three for the coarser, heavier-textured, and darker-coloured leaves, as these always contain more albuminous matter. New Zealand tobacco-leaf so handled will compare quite well with imported American leaf of similar age and grade.

The manufacturers in New Zealand only import certain grades of tobacco-leaf, suitable for their immediate requirements. On the other hand, all grades of New-Zealand-grown leaf have to be handled. The fine, well-coloured, high-grade leaf is quickly disposed of, but the lower grades and discoloured dark leaves are not in great demand. These are usually poorly handled, and are very freely commented upon and condemned by manufacturers.

The proportion of good-quality leaf produced on American farms is said to be higher than the average in New Zealand; but if such is the case at present, due to the limited experience of our growers, it is a condition that is capable of being steadily improved.

—*C. Lowe, Tobacco Instructor, Horticulture Division*

WEATHER RECORDS: FEBRUARY, 1931.

Dominion Meteorological Office.

THE principal characteristics of the weather in February were low temperatures and an unusual amount of wind. There were several periods of strong northerly winds, which were followed by spells of southerlies. The latter, though not so severe, were unusually persistent for this time of year. Nevertheless a number of beautifully fine days were experienced, and in some respects the month was more summer-like that its predecessors. Rainfall was generally below normal in the North Island and Nelson, and above normal over the remainder of the South Island. The cold weather and some very dry spells at critical periods had an adverse effect on wheat crops, and the growth of vegetation generally was retarded. Except in the Hawke's Bay and Gisborne districts, however, pastures are in fair condition and stock doing well.

Rainfall.—The total falls were much below average in the northern and eastern parts of the North Island. In Taranaki the deficits were less marked and a few places had more than the normal. In the South Island the Nelson Province generally had less than the average, but heavy rains on the 22nd considerably relieved the situation. Hokitika and parts of North Canterbury also had rather less than the average. Elsewhere there was an excess, and the southern half of the South Island experienced a very wet month.

Temperatures.—As already stated, the month was unusually cool. Temperatures were much below normal in all parts of the Dominion. In some places it was the coldest February on record. Numbers of places experienced one or more frosts.

Pressure Systems.—From the 1st to the 3rd a series of westerly depressions passed. Northerly gales blew in places on the 2nd. In Cook Strait some high velocities were reached. Heavy rain fell on the West Coast of the South Island, Harihari experiencing a very heavy flood.

A southerly spell followed, and an anticyclone moved slowly across the Dominion. From the 6th to the 10th the weather was mostly fine, though still rather cool.

Another westerly depression passed rapidly during the night of the 11th, and was followed by strong southerlies and very cold and showery weather. Heavy rain fell in eastern districts of the South Island on the 12th, and the ranges received a fall of snow. On the 13th there were widespread thunder and hail storms, which were particularly severe in the southern half of Auckland Province.

On the 15th a dying cyclone crossed the Auckland Peninsula, causing thunderstorms and heavy rain, though Southern districts were unaffected. Otherwise anticyclonic conditions and fair weather were the rule until the 19th. Thereafter a further series of westerly depressions was responsible for a period of very stormy weather. On the 22nd northerly gales were widespread and heavy rain was almost general. A cyclonic centre developed west of Greymouth, and exceptionally heavy rain occurred as it moved eastward; 12·50 in. fell at Greymouth in about twelve hours, constituting the heaviest fall ever recorded there. Arthur's Pass had 11·32 in. During the 23rd and 24th the winds backed again to cold, strong southerlies. Hail and thunderstorms were reported from many places on the 23rd, and on the 24th there was a heavy snowfall on the ranges of the South Island.

From the 25th onward the weather improved under the influence of another intense anticyclone.

RAINFALL FOR FEBRUARY, 1931, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average February Rainfall.
	North Island.	Inches.		Inches.	Inches.
1	Kaitaia	0·61	6	0·40	3·59
2	Russell	0·61	3	0·52	2·78
3	Whangarei	0·91	7	0·44	4·00
4	Auckland	1·61	9	0·70	3·04
5	Hamilton	1·48	5	0·58	2·97
6	Rotorua	1·79	4	1·54	3·78
7	Kawhia	2·50	10	0·80	2·79
8	New Plymouth	2·08	11	0·96	3·87
9	Riversdale, Inglewood ..	3·08	8	1·60	6·15
10	Whangamomona	4·25	6	2·23	3·92
11	Eltham	3·58	8	2·15	3·21
12	Tairua	1·14	5	0·86	4·11
13	Tauranga	1·79	7	0·91	3·40
14	Maraehako Station, Opotiki	1·04	5	0·86	3·44
15	Gisborne	0·29	6	0·09	3·31
16	Taupo	1·37	6	0·96	2·79
17	Napier	..	..	..	2·81
18	Hastings	0·34	4	0·17	2·37
19	Taihape	2·43	7	0·60	2·24
20	Masterton	1·25	7	0·37	2·76
21	Patea	2·17	10	0·74	2·50
22	Wanganui	2·75	6	0·90	2·44
23	Foxton	1·05	5	0·45	2·11
24	Wellington (Karori Reservoir)	1·82	8	0·85	3·01
	South Island.				
25	Westport	4·28	13	1·20	5·35
26	Greymouth	15·82	12	12·50	6·10
27	Hokitika	6·93	11	3·09	7·22
28	Ross	10·98	11	4·36	8·85
29	Arthur's Pass	20·48	9	11·32	9·56
30	Okuru	15·06	8	6·23	8·72
31	Bainham	7·95	13	4·59	9·18
32	Nelson	2·27	5	2·13	2·64
33	Spring Creek	3·50	5	2·25	2·22
34	Tophouse	3·73	8	2·10	3·92
35	Hanmer Springs	3·56	8	1·41	2·90
36	Highfield, Waiau	2·42	7	1·12	2·63
37	Gore Bay	2·62	7	1·86	2·76
38	Christchurch	2·02	8	0·79	1·73
39	Timaru	2·24	7	0·70	1·77
40	Lambrook Station, Fairlie	2·04	6	0·74	1·82
41	Benmore Station, Clearburn	3·51	10	1·08	1·33
42	Oamaru	2·49	11	0·50	1·73
43	Queenstown	3·12	9	1·50	1·95
44	Clyde	2·12	9	0·92	1·04
45	Dunedin	4·92	14	1·05	2·74
46	Wendon	4·23	13	1·48	2·04
47	Gore	3·75	16	0·97	2·65
48	Invercargill	5·24	16	1·80	2·99
49	Puysegur Point	7·67	19	2·43	5·76
50	Half-moon Bay	5·09	15	1·72	4·21

—*Edward Kidson, Director of Meteorological Services, Wellington, 6/3/31.*

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

MAMMITIS INFECTION.

W. H. S., Eltham :—

Can you tell me whether, where a farm has had cows with mammitis running on it and they are taken away and some other cows put on, these others run the risk of taking the complaint ? If so, would it be safe to put heifers on, providing they were taken away before they were put to the bull ? If the land does become infected, would it be necessary to keep cattle off altogether to get it clean again ?

The Live-stock Division :—

The causal organism of mammitis is present in insanitary yards and milking-sheds, and it is not necessary to have infected animals on the farm to transmit the disease. After infected cows have been removed from a farm there is no particular danger in putting on fresh cows. The risk of contracting mammitis is one that is always present on every farm, but the risk is not greater on pastures which have been grazed by infected animals. The main danger-points would appear to be insanitary yards and sheds and infected milking-machines. A thorough clean-up in this direction, the application of slaked lime to earthen yards, and the sterilization by boiling of milking-machine parts likely to come in contact with the teats, appear to be all that is necessary. The land does not become infected in the general sense of the term ; sunlight and drying are effective preventive measures against this taking place. Free movement of cattle can therefore be advised without risk, but it must be remembered that all cows are susceptible subjects to mammitis, and that management of the herd plays an important part in the prevention of this trouble.

NITRATE OF SODA FOR THE GARDEN.—NICOTINE SPRAY FROM PIPE TOBACCO.

"FARMER'S WIFE," Otorohanga :—

(1) With regard to supplying nitrate of soda at a strength of one teaspoon to 1 gallon of water to vegetables, will you please tell me if it can be applied equally well to all vegetables and at any stage in their growth ?

(2) On page 67 of the January issue appears a paragraph entitled "An Effective Nicotine Spray." May a satisfactory concentrated nicotine extract be obtained when boiling water is poured on ordinary pipe-tobacco ?

The Horticulture Division :—

(1) The nitrate-of-soda solution should be applied only during the growing-period. It is used specially in the spring-time to encourage growth. Used to excess it would often delay flowering and even diminish it—in the case of tomatoes, for instance. After the fruit has set it may be given to tomato-plants to help develop the fruit. It is especially useful in growing tender cabbage and salad plants, but should be used with caution in autumn, as it may make plants susceptible to frost injury. A little sulphate of potash can usually be added with advantage.

(2) Ordinary pipe-tobacco may be used for this purpose. Let the tobacco become dry and rub it down fine. Take 2 lb. tobacco, 7 oz. quicklime, and 3 gallons water. Heat a little water and slake the lime ; pour the milk of lime into the remainder of the water. Stir in the tobacco-dust and let it stand for thirty-six hours, stirring it twice a day. Then strain through coarse sacking, and wash the residue with water until the volume of liquor measures 3 gallons. Add an equal quantity of water, making it up to 6 gallons, and it is ready for use.

HORSE TROUBLED WITH ITCH.

"LADDIE," Riverton :—

I should be obliged if you could give a diagnosis and remedy for a kind of itch which is troubling one of my horses. There is no sign of lice about the animal, but his hair is coming off, particularly about head, legs, and breast, apparently with rubbing, and the skin is rubbed raw in many places, chiefly inside hind legs, breast, and head. I have tried bathing with a disinfectant, but it seems to have no effect.

The Live-stock Division :—

The development of an eczematous inflammation of the skin, accompanied by severe itching, is not unrare in horses, and does not always readily respond to treatment. The exact cause of the complaint is not definite ; it is certainly influenced by external factors, and may be dietetic in origin. A drawback to treatment is hair, and we would suggest that the horse be clipped. Usually wetting and washing with soap should be avoided, but if it is necessary to remove scales, exudate, &c., the areas should be thoroughly dried immediately afterwards. The parts affected should be swabbed twice daily with the following liniment : Strong solution of lead subacetate (Goulard's Extract), 5 oz. ; olive oil, 2 pints. The best endeavour possible should be made to prevent the animal further rubbing itself. Attention must be paid to the diet, which should be laxative. We suggest giving the horse 1 pint of raw linseed oil, following this up by a course of alterative medicine. Get a chemist to make up the following prescription and divide it into twenty-four powders for you : Acidi arseniosi, 2 drachms ; Ferri sulph. exsicc, 3 oz. ; Sodii bicarb., 8 oz. ; Pulv. anisi., 6 oz. Give the horse one of the powders daily in a small feed.

ARSENICAL SOLUTION FOR PRESERVING SHEEP-SKINS.

R. M., Te Kuiti :—

Could you please give me a recipe for making up arsenic solution suitable for swabbing sheep-skins for preserving them from rats and weavils ?

The Live-stock Division :—

You could not do better than use an arsenical sheep-dip, painted on at double the strength you would use for dipping.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 31st December, 1930, to 12th March, 1931, include the following of agricultural interest :—

No. 63183 : Milking-machine ; J. Taylor and Co., Ltd., Eltham. No. 63331 : Grass-seed stripper ; P. R. Whisker, Bulls. No. 64328 : Milking-machine pulsator ; A. B. Robertson, Hamilton. No. 65902 : Spraying-nozzle ; W. R. Argue, Mahana. No. 66062 : Wool-press ; Donald and Sons, Ltd., Masterton. No. 64795 : Seed-disinfectant composition ; Imperial Chemical Industries, Ltd., London. No. 63323 : Wool-bale hook ; P. T. Webb, Melbourne. No. 64462 : Manure-distributor ; R. H. Roberts, Henderson. No. 64587 : Harrow ; A. J. T. Bracey, Waimamaku. No. 66244 : Hay-loader ; T. E. Knapp, Clanfield, England. No. 66250 : Potato-digger ; J. E. Thompson, Tankerton, Fresh Island, Aust. No. 63943 : Hedge-shears ; D. Wenham, Hamilton East. No. 64493 : Producing dried-milk powder ; New Zealand Sugar of Milk and Casein Co., Ltd., Dunedin. No. 64961 : Hay-press ; G. T. Clunie and G. H. Baucke, Paraparaumu. No. 64729 : Cultivating-implement ; F. T. F. Evans, Auckland. No. 65944 : Cheese-crate-batten making ; Collett and Son, Ltd., Mangatera. No. 66063 : Wire-strainer ; Donald and Sons, Ltd., Masterton. Nos. 65525 and 65526 : Milk-container ; Cheshire Dairies, Ltd., Manchester, Eng.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

SUPPLEMENTARY LIST OF CERTIFIED PERENNIAL RYE-GRASS AREAS.

A LIST of the areas of perennial rye-grass inspected and passed in the field this season was published in last month's *Journal*. The following areas (late entries) are supplementary to the main list:—

Name.	Address.	Mother Seed Areas.	Permanent Pasture Areas eligible for Reclassification as Mother Seed Areas.	Permanent Pasture Areas not eligible for Reclassification.	First Harvest Seed Areas.
	Poverty Bay.	Acres.	Acres.	Acres.	Acres.
Cameron, R. ..	Repongaere ..	..	6	..	..
Gibson, C. ..	Matawhero ..	..	..	..	12
Pilmer, W. C. ..	Makaraka ..	..	58	..	..
	Hawke's Bay.				
Holden, L. S. ..	Mangateretere ..	..	24	..	..

LAND HOLDINGS IN NEW ZEALAND.

THE following table gives particulars of occupied holdings of 1 acre and over in the several land districts of the Dominion in 1930. The average area per holding in 1929 is also included for purposes of comparison:—

Land District.	Number of Holdings occupied.	Aggregate Area.	Average Area per Holding.	
			1930.	1929.
North Island—		Acres.	Acres.	Acres.
North Auckland	13,892	2,978,367	214·39	215·16
Auckland	12,885	4,190,458	325·22	331·88
Gisborne	2,911	2,715,996	933·01	945·61
Hawke's Bay	4,487	2,099,207	467·84	464·16
Taranaki	6,451	1,683,212	260·92	258·37
Wellington	10,885	4,934,689	453·35	452·11
South Island—				
Nelson	3,583	1,270,806	354·68	343·88
Marlborough	1,925	2,482,754	1,289·74	1,279·82
Westland	1,433	1,590,409	1,109·85	1,054·10
Canterbury	13,161	8,156,080	619·72	617·98
Otago	7,745	8,037,693	1,037·79	1,022·68
Southland	5,809	3,228,982	555·86	553·40
Totals for Dominion ..	85,167	43,368,653	509·22	508·42

—*Census and Statistics Office.*

Correction.—Referring to the article "Tuberculosis of Farm Animals," on page 120 of last month's *Journal*, in the paragraph dealing with the making of tuberculin, the words "a 5-per-cent. solution of carbolic acid is then added as a preservative" should read "0·5 per cent. carbolic acid is then added as a preservative."